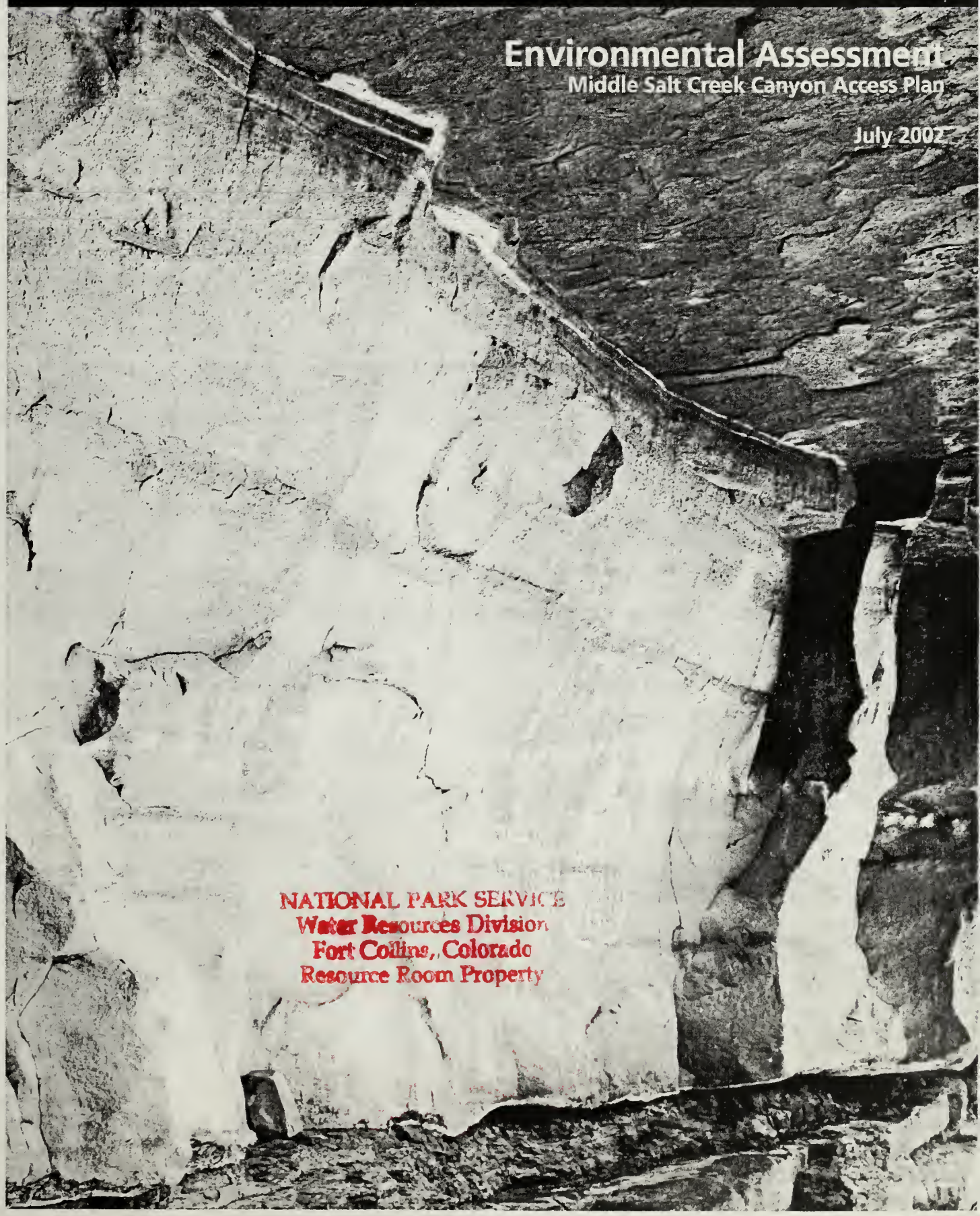
Canyonlands

National Park Service
U.S. Department of the Interior

Canyonlands National Park



Environmental Assessment

Middle Salt Creek Canyon Access Plan

July 2002

ENVIRONMENTAL ASSESSMENT

MIDDLE SALT CREEK CANYON ACCESS PLAN

CANYONLANDS NATIONAL PARK, UTAH

Summary

Salt Creek is the largest drainage in the Needles district of Canyonlands National Park. The creek supports one of the most important riparian ecosystems in the park. It is also the heart of the Salt Creek National Register Archeological District, the area with the highest recorded density of archeological sites in the park. A tributary canyon contains the spectacular Angel Arch, a well-known geologic formation that for many years has been a destination point for park visitors.

In 1998 the U.S. District Court for the State of Utah ruled, in a lawsuit filed by the Southern Utah Wildemess Alliance, that the National Park Service violated the NPS Organic Act (16 U.S.C. 1 *et seq.*) by failing to close the upper 8.2 miles (above Peekaboo campsite) of the Salt Creek four-wheel drive road in the 1995 Canyonlands Backcountry Management Plan. The jeep road weaves in and out of the creek, sometimes remaining in the streambed for extended lengths. The court found that vehicles upstream of Peekaboo Spring caused permanent impairment of park resources, and enjoined the NPS from continuing to allow limited use of the area by motorized vehicles.

Four-wheel-drive groups appealed the decision, and in 2000 the U.S. Tenth Circuit Court of Appeals remanded the case to the district court. The remand included instructions to re-examine the administrative record and consider the new NPS Management Policies in regard to the question of "impairment of park resources or values," the central issue in the case.

With the concurrence of the U.S. District Court of Utah, the NPS has prepared an environmental assessment (EA) to analyze the impacts of a range of alternatives for recreational access to the portion of Salt Creek Canyon from Peekaboo Camp to Angel Arch Canyon ("Middle Salt Creek Canyon"), and to apply the new NPS Management Policies on impairment to the alternatives.

The management objective, toward which the EA alternatives are directed, is based on the NPS Organic Act, the act establishing Canyonlands National Park, and the issues on remand to the district court:

> To provide recreational access to Middle Salt Creek Canyon without major adverse impacts or impairment of the natural and cultural resources.

The list of possible management alternatives includes limited year-around vehicle access under the permit system established in the 1995 Backcountry Management Plan (BMP), part-year vehicle access under the permit system, realignment of the existing four-wheel-drive road, year-round prohibitions on motorized vehicles, or a combination of these actions. The three vehicle-access alternatives, each of which would permit vehicle travel through substantial portions of the streambed and riparian area, have been found to cause impairment of park resources or values, which is prohibited by the National Park Service Organic Act. Consequently, an alternative prohibiting motorized vehicles year-round, but permitting access by hiking or pack stock, is identified as the preferred alternative.

Note to Reviewers and Respondents

If you wish to comment on the environmental assessment, you may mail comments to the name and address below. Our practice is to make comments, including names and home addresses of respondents, available for public review during regular business hours. Individual respondents may request that we withhold their home address from the record, which we will honor to the extent allowable by law. **If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment.** We will make all submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public inspection in their entirety.

Please address written comments to:

Alford J. Banta
Superintendent, Canyonlands National Park
2282 South West Resource Blvd.
Moab, UT 84532

TABLE OF CONTENTS

FIGURES

TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

BLM	Bureau of Land Management
BMP	Backcountry Management Plan
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973
ft	foot/feet
GMP	General Management Plan
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
NRCS	Natural Resources Conservation Service
PFC	Properly Functioning Condition (riparian/wetland areas)
PMF	probable maximum flood
RVD	recreation visitor-day
SHPO	State Historic Preservation Office
sq ft	square feet
USC	U.S. Code
USDI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

1. PURPOSE AND NEED

1.1 Introduction

Salt Creek, in the Needles district of Canyonlands National Park, is in a remote part of southeastern Utah, approximately 50 miles from the nearest town of Monticello (Figure 1). Salt Creek supports one of the most important riparian ecosystems in the park. It is also the heart of the Salt Creek National Register Archeological District, the area with the highest recorded density of archeological sites in the park. A tributary canyon contains the spectacular Angel Arch, a well-known geologic formation that for many years has been a destination point for backcountry visitors.

Salt Creek begins on the north side of the Abajo Mountains in Manti-LaSal National Forest, about five miles south of the southern boundary of Canyonlands National Park. From the south park boundary the creek runs northerly about 32 miles, where it joins the Colorado River. Sections of the creek have year-round surface water, supported by several springs. In other sections surface flow is intermittent, resulting from spring snowmelt and storm runoff. Surface and ground water associated with the creek support the most extensive riparian ecosystem in the park, other than the Green and Colorado Rivers.

Contemporary knowledge of the Needles and Salt Creek was limited to nearby ranchers and cowboys until about the late 1940s. At that time a few people began to explore the Needles area by horseback, foot, or jeep. In Salt Creek Canyon and other drainages they generally traveled in and alongside the streambed. After Canyonlands National Park was created in 1964, the park continued to allow motorized, street-legal vehicles to travel in Salt Creek Canyon and on other designated primitive roads in backcountry areas. Salt Creek was also used for livestock grazing continuously from before the turn of the 20th century until the mid-1970's.

The Salt Creek four-wheel-drive road is a single-lane unimproved track that runs from a gravel all-weather park road in the vicinity of Cave Spring, for approximately 11 miles to a side canyon sometimes known as Angel Arch Canyon, then continues another mile up this canyon to the terminus in the vicinity of Angel Arch. Above Angel Arch Canyon, the creek continues, without a road, approximately 12 miles to the south park boundary. In the 8.2 miles between Horse Canyon and Angel Arch Canyon, the four-wheel drive road weaves in and out of the streambed and crosses the channel about 60 times, in places remaining in the streambed for considerable distances. There are no man-made structures (culverts, bridges etc.) along the route. NPS maintenance of the road has been limited to occasional grading or filling of sections that have become impassable because of flooding or erosion from vehicle travel. Vehicle passage can be challenging, and quicksand along the route periodically traps vehicles. Below Cave Spring, the creek continues, without a road, for about 9 miles to its confluence with the Colorado River (Figure 2).

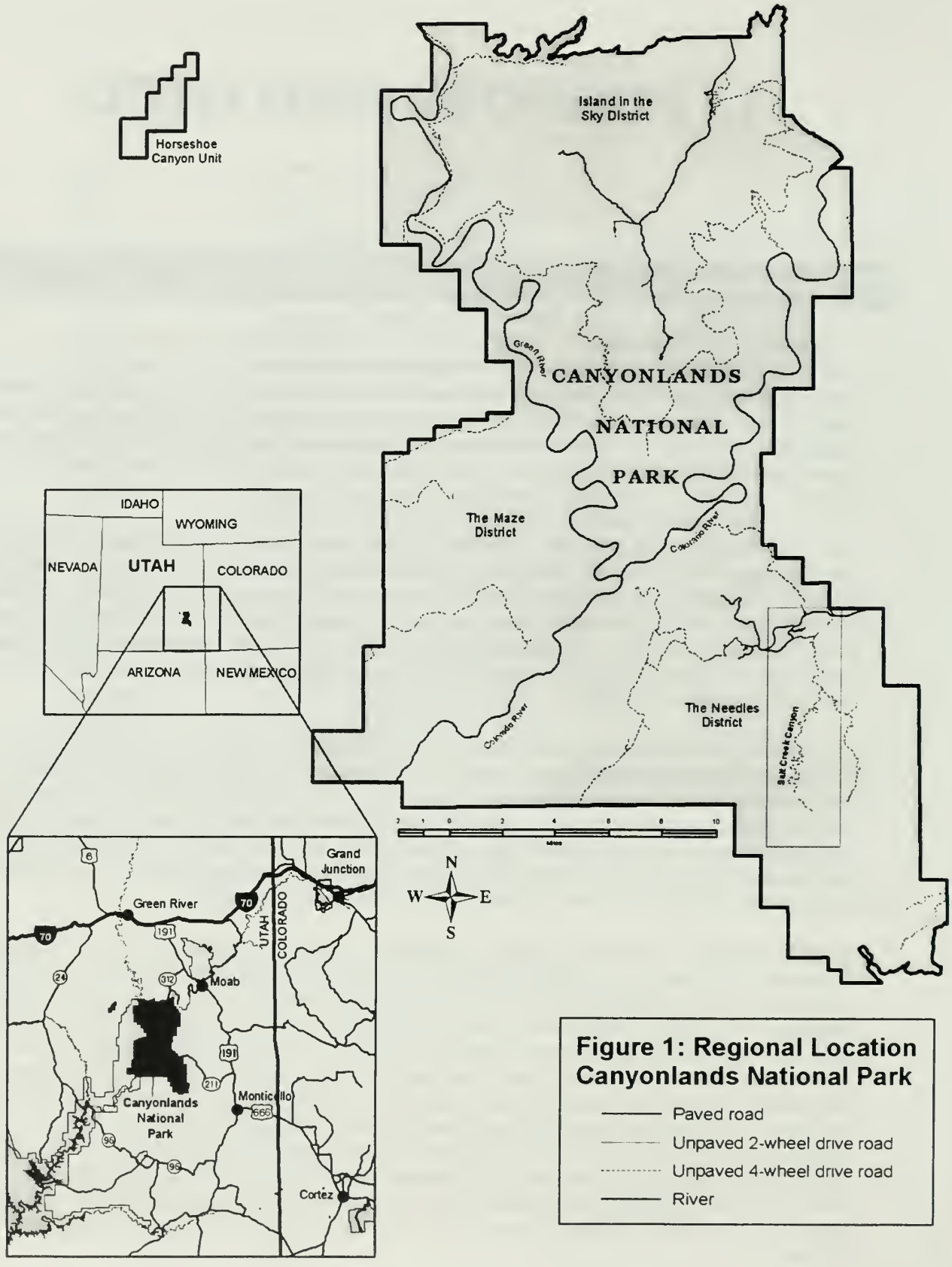
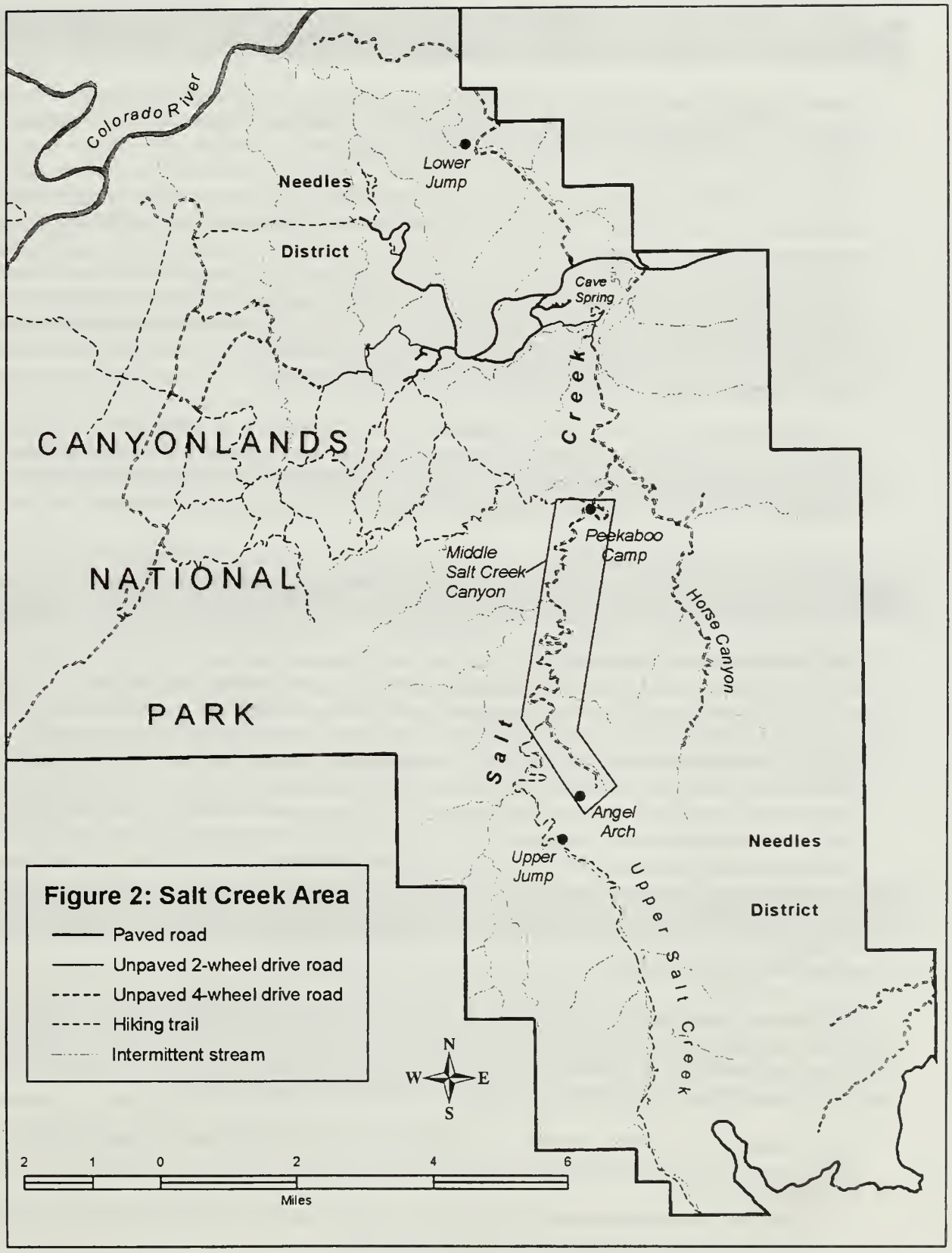


Figure 1: Regional Location Canyonlands National Park

- Paved road
- Unpaved 2-wheel drive road
- Unpaved 4-wheel drive road
- River


Colorado River
Needles
District
Lower
Jump
Cave
Spring
Salt
Creek
CANYONLANDS
NATIONAL
PARK
Middle
Salt Creek
Canyon
Peekaboo
Camp
Horse Canyon
Salt
Creek
Angel
Arch
Upper
Jump
Needles
District
Upper Salt Creek
Figure 2: Salt Creek Area
Paved road
Unpaved 2-wheel drive road
Unpaved 4-wheel drive road
Hiking trail
Intermittent stream
N
W
E
S
2
1
0
2
4
6
Miles

1.2 Purpose and Need

Canyonlands National Park was established by Congress ". . . to preserve an area in the State of Utah possessing superlative scenic, scientific, and archeological features for the inspiration, benefit and use of the public" (Public Law 88-590, 1964).

In 1998 the U.S. District Court for the State of Utah ruled, in a lawsuit filed by the Southern Utah Wilderness Alliance (*SUWA v. National Park Service*, et al., Civil No. 2:95 CV 0559K), that the National Park Service violated the NPS Organic Act (16 U.S.C. 1 et seq.) by failing to close the upper 8.2 miles (above Peekaboo campsite) of the Salt Creek four-wheel drive road in the 1995 Canyonlands Backcountry Management Plan. Research had indicated that the road was adversely impacting the stream and riparian area. The court found that vehicles upstream of Peekaboo Spring caused permanent impairment of park resources, and enjoined the NPS from continuing to allow limited use of the area by motorized vehicles.

Four-wheel-drive groups appealed the decision, and in 2000 the U.S. Tenth Circuit Court of Appeals remanded the case to the district court. The remand included instructions to re-examine the administrative record and consider the new NPS Management Policies in regard to the question of "impairment of park resources or values," the central issue in the case.

The NPS considered a number of factors in developing a course of action subsequent to the ruling of the Tenth Circuit. First, the decision in the original 1995 BMP planning process was an interim action intended to allow limited access in the canyon to Angel Arch, and to monitor the impacts of the continued motorized use to determine if the impacts to Salt Creek Canyon were sufficiently mitigated. Both the BMP and court briefs indicated the issue was intended to be revisited in approximately five years after the park had more opportunity to monitor and study impacts. Second, the environmental assessment (EA) for the BMP did not examine a number of alternatives that might have mitigated vehicular impacts, such as seasonal closures and realignment of some sections of the road from the creek bottom. Third, the vehicle injunction provided the first longer-term opportunity to monitor Salt Creek resource conditions without vehicle traffic since the park was established in 1964; new scientific information gathered during this period was important to the question of impairment of park resources. In addition, the NPS had issued new management policies relating to determinations of impairment. Consideration of these factors led the park to initiate a new EA process on Salt Creek access, addressing the issues on remand to the district court, and to request a stay of the judicial proceedings. Consequently, the district court stayed the proceedings related to the impairment issue until completion of the new EA.

With the concurrence of the U.S. District Court of Utah, and in accordance with the National Environmental Policy Act, the NPS has prepared an environmental assessment to analyze the impacts of a range of alternatives for recreational access to the the portion of Salt Creek Canyon from Peekaboo Camp to Angel Arch Canyon ("Middle Salt Creek Canyon").

The management objective, toward which the alternatives in this EA are directed, is based on the NPS Organic Act, the act establishing Canyonlands National Park, and the issues on remand to the district court:

> To provide recreational access to Middle Salt Creek Canyon without major adverse impacts or impairment of the natural and cultural resources.

The alternative selected for implementation will be known as the "Middle Salt Creek Canyon Access Plan" and will be appended to the existing 1995 Canyonlands Backcountry Management Plan.

Management of the remainder of Salt Creek Canyon and the rest of the backcountry of Canyonlands National Park is covered in the 1995 Backcountry Management Plan, and is not addressed in this document for reasons outlined in section 1.3. Future significant changes in Canyonlands backcountry management would be dealt with by revising the BMP or through development of a new General Management Plan (GMP) for the park.

Subsequent to initiation of this EA, San Juan County, Utah and the State of Utah were joined by the plaintiffs in the case of *SUWA v. National Park Service, et al.*, Civil No. 2:95 CV 0559K, in order to resolve issues related to a County and State claim to a highway right-of-way in Salt Creek Canyon pursuant to R.S. 2477. National Park Service personnel then examined available information relating to the claim, and prepared a preliminary assessment which concluded that based on the materials reviewed to date, there was insufficient information to establish a valid R.S. 2477 right-of-way.

A copy of the preliminary assessment is attached at Appendix 4. This preliminary assessment does not represent a title determination, and public comment on it is not presently being sought.

1.3 Scope

For the purpose of this EA, the area being assessed includes the portion of Salt Creek Canyon from Peekaboo Camp to the junction of Angel Arch Canyon, plus Angel Arch canyon from that junction to the end of the four-wheel-drive road near Angel Arch, a length of about 8.2 miles of canyon (see Figure 2). However, in order to comparatively evaluate the effects of vehicle traffic and other access alternatives, two other sections of Salt Creek are also examined. These are the section above (upstream of) the turnoff to Angel Arch Canyon, and the section from Cave Spring to Peekaboo.

1.4 Public Involvement

The public was provided the opportunity to identify issues and suggest management alternatives during a 60-day scoping period that included six "open house" meetings. About 130 people attended the open houses, and approximately 2500 mailed or e-mailed written comments were received. Of the public responses received, about 81 percent favored a year-around prohibition on motorized travel in Salt Creek Canyon, while about 19 percent favored some sort of vehicle access. A number of issues were raised by the public, and these are consolidated and included in the "Impact Topics" outlined in the next section.

1.5 Impairment of Park Resources or Values

National Park Service policy (*Management Policies, 2001*) requires analysis of potential effects to determine whether or not actions would impair park resources.

The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. National Park Service managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources. Although Congress has given the National Park Service the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible National Park Service manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute an impairment. An impact would be more likely to constitute an impairment to the extent it affects a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park. This environmental assessment will analyze the potential effects of all alternatives presented to determine if the alternative would result in an impairment of park resources. An impairment finding is included in the conclusion section for each impact topic.

1.6 Issues/Impact Topics

1.6.1 Issues and Derivation of Impact Topics

Issues and concerns affecting this project were identified by NPS specialists, and included the input of other federal, state, and local agencies, and the public. After public scoping, issues and concerns were distilled into distinct impact topics to facilitate the analysis of environmental consequences, which allows for a standardized comparison between alternatives based on the most relevant information. The impact topics were identified on the basis of federal laws, regulations, and orders, *NPS Management Policies* (2001), and NPS knowledge of potentially

affected resources.

1.6.2 Impact Topics Selected for Detailed Analysis

Impact topics identified and examined here include the effects of visitor use (both motorized and non-motorized) in the affected area of Salt Creek Canyon on:

- Threatened and Endangered Species
- Wildlife
- Natural Soundscape
- Recreational Experience
- Cultural Resources
- Riparian/Wetland Ecosystem
- Economic Environment
- Wildemess

Each of these impact topics is fully described in this document under Section 3, Affected Environment.

1.6.3 Impact Topics Dismissed From Detailed Analysis

The rationale for dismissing specific topics from further consideration is given below:

1.6.3.1 Prime and Unique Farmlands: In August 1980, the Council on Environmental Quality (CEQ) directed that federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department or Agriculture's Natural Resource Conservation Service (NRCS) as prime or unique. Prime or unique farmland is defined as soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables, and nuts. According to NRCS, none of the soils in the project area are classified as prime and unique farmlands. Therefore, the topic of prime and unique farmlands was dismissed as an impact topic in this document.

1.6.3.2 Environmental Justice: Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low-income Populations", requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. The EA alternatives would not have health or environmental effects on minorities or low-income populations or communities as defined in the Environmental Protection Agency's Environmental Justice Guidance. Therefore, Environmental Justice was dismissed as an impact topic in this document.

1.6.3.3 Air Quality: The 1963 Clean Air Act, as amended (42 USC 7404 et seq.), requires federal land managers to protect park air quality. NPS *Management Policies 2001* (USDI National Park Service 2001) address the need to analyze air quality during park planning. Canyonlands National Park is designated as a Class I airshed under the Clean Air Act. Class I areas require that ambient air quality must essentially remain unchanged and cannot sustain increases in air pollution above baseline levels. The altematives described here may result in some short-term, localized decreases in air quality, but the altematives do not impact long-term air quality. Humans and wildlife in the vicinity of operating vehicles may experience the smell of engine exhaust to varying degrees, depending on the condition of the vehicle (which may affect

the amount and content of exhaust), the sensitivity of the affected individual, and local weather conditions. The proposed action would have no measurable effect on the overall air quality of Canyonlands National Park, as currently monitored.

1.6.3.4 Upland Ecosystem: The ecosystem primarily affected by the alternatives in this EA is the riparian ecosystem. Adjacent and above the riparian system is an upland desert shrub community, dominated by common species such as big sagebrush, rabbitbrush, fourwing saltbush, native grasses and non-native cheatgrass, along with occasional galleries of large cottonwoods established before the stream downcut to its present level. Surface interspaces between vascular plants are generally covered with cryptobiotic soil crust.
Three of the four alternatives would have little or no new impact on the upland ecosystem. Alternative C would relocate sections of the road from the streambed and riparian area, creating approximately 2.3 linear miles of new four-wheel-drive road, or about 3.5 acres of disturbed surface, in the upland ecosystem, with minor long-term impacts. Additional stream sedimentation expected from this alternative is discussed in the riparian ecosystem sections. Because only one alternative, which is not the preferred, would have minor effects on the upland ecosystem, this topic was dismissed from detailed analysis.

1.6.3.5 Historic Structures: There are no known historic structures (architectural) in either the project area or its general vicinity.

1.6.3.6 Museum Collections: The Salt Creek Archeological District is cited in the 1997 Canyonlands National Park, Scope of Collections Statement, as source of significant resources in the park's museum collection. Over 2000 artifacts including archives are derived from Salt Creek Archeological District. Any alternative that requires recovery of artifacts will result in the creation of archives, and deposition of artifacts into the park museum. Because archeological materials can be accommodated at the Southeast Utah Group Museum Storage Facility, museum collections were dismissed as an impact topic.

1.6.3.7 Cultural Landscapes: According to the NPS Cultural Resource Management Guideline (DO-28), a cultural landscape is:

> ...a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built. The character of a cultural landscape is defined both by physical materials, such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions. (USDI National Park Service 1998b)

There are no identified cultural landscape resources in either the area of the proposed action or its general vicinity. Copies of the EA will be made available to tribes for review and comment. If tribes subsequently identify the presence of cultural landscapes, then consultation would be continued by NPS with those tribes. Because there are no known cultural landscapes within the area of the proposed action, cultural landscape resources were dismissed as an impact topic.

1.6.3.8 Ethnography: Ethnographic resources are defined by NPS as any "site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it" (Cultural Resource Management Guideline, DO-28: 191; USDI National Park Service1998b). Tribal notification regarding the National Park Service beginning an Environmental Assessment for Salt Creek Road was initiated in February 2001. Over 20 tribes and tribal agencies were notified and invited to participate in the Salt Creek Road EA. A Tribal response was received

from the Hopi Tribe (March 2001) in which Hopi Tribe claims cultural affiliation to the prehistoric cultural groups in Canyonlands National Park and is "concerned about the effects of motorized travel on riparian ecosystems, wetlands, archaeological features, and water quality." Subsequent tribal notification about this EA was again communicated to Navajo Nation, Ute Mountain Ute Tribe, Ute Indian Tribe (Fort Duchesne, Utah), and Zuni Pueblo in September 2001. There have been no additional Tribal responses to date. Because no Traditional Cultural Places (TCPs) or ethnographic sites were identified in the project area or vicinity through tribal consultation or on-the-ground surveys, ethnography was dismissed as an impact topic.

1.6.3.9 Wild and Scenic Rivers: Salt Creek was evaluated by park staff for eligibility for the National Wild and Scenic Rivers system in 1990. The upper ten miles, above the old Bates Wilson campsite, were found to be eligible; the remainder was found to be ineligible. Because the EA alternatives would have no effect on the eligible section of Salt Creek, Wild and Scenic Rivers were dismissed as an impact topic.

2. ALTERNATIVES

2.1 Introduction

A range of alternatives was developed, directed at the management objective of providing recreational access to Middle Salt Creek Canyon (from Peekaboo Camp to Angel Arch Canyon) without major adverse impacts or impairment of the natural and cultural resources. Ideas for alternatives came from NPS staff, other resource experts, and the public.

Four alternatives were analyzed in detail, and are described in section 2.2. A number of additional alternatives were considered but eliminated from detailed study for various reasons. These are described in section 2.3.

Part of the intent of conducting a new planning process for Salt Creek was to examine alternatives that had not been analyzed in the previous Canyonlands backcountry management planning process and that might mitigate Salt Creek vehicle impacts. Two of the alternatives analyzed in detail, alternatives B and C, were modifications of alternative A that attempt to mitigate vehicle impacts. Alternative A was originally developed during the earlier backcountry management planning process, and was aimed at mitigating impacts from previously unlimited vehicle traffic.

The no-action alternative, alternative A, was the alternative selected in the 1995 Backcountry Management Plan (BMP), and was in effect from 1995 until 1998, when vehicle travel above Peekaboo was enjoined by federal district court order. This injunction was vacated by the federal appellate court in 2000, so that this alternative would be in force if existing management direction were continued. The NPS has implemented a temporary prohibition of motorized vehicles in Salt Creek above Peekaboo while it analyzes resource conditions and proceeds with the new National Environmental Policy Act (NEPA) process to consider alternatives for Salt Creek.

Level of accomplishment of the objective, for the four alternatives analyzed in detail, is summarized in Table 1.

Table 1. Comparative Summary of Alternatives and Extent to Which Each Meets the Plan Objective (to provide recreational access to Middle Salt Creek Canyon without major adverse impacts or impairment of the natural and cultural resources)

Note: Impacts are adverse unless specifically noted as beneficial.

Impact Topics	Alternatives			
	A Vehicle access all year by permit system	B Vehicles access part-year by permit system	C Road realigned, vehicle access all year by permit system	D Vehicles prohibited all year
THREATENED, ENDANGERED AND SENSITIVE SPECIES	Minor direct and indirect impacts; moderate cumulative effects; no impairment. **Objective met.**	Negligible direct impacts; minor indirect impacts; no impairment. **Objective met.**	Minor direct and indirect impacts; no impairment. **Objective met.**	Minor direct beneficial impacts; minor to moderate indirect beneficial impacts; no impairment. **Objective met.**
WILDLIFE	Minor direct impacts; minor to moderate indirect impacts. Major impacts to individuals in cases of death or injury. No impairment. **Objective not met.**	Minor direct impacts; minor to moderate indirect impacts. No impairment. **Objective met.**	Minor direct impacts; minor to moderate indirect impacts. Major impacts to individuals in cases of death or injury. No impairment. **Objective not met.**	Minor to moderate direct beneficial impacts; minor to moderate indirect beneficial impacts; no impairment. **Objective met.**
NATURAL SOUNDSCAPE	Moderate direct impacts. No impairment. **Objective met.**	Moderate direct impacts; no impairment. **Objective met.**	Moderate direct impacts; no impairment. **Objective met.**	Moderate direct beneficial impacts; no impairment. **Objective met.**
RECREATION EXPERIENCE				
• Accessibility	Moderate direct beneficial impacts for general accessibility. No impairment. **Objective met.**	Moderate direct impacts for general accessibility. No impairment. **Objective met.**	Moderate direct beneficial impacts for general accessibility. No impairment. **Objective met.**	Moderate to major direct impacts for general accessibility. No impairment. **Objective partly met.**
• Hiking	Minor impacts for hikers. No impairment. **Objective met.**	Minor impacts for hikers. No impairment. **Objective met.**	Minor impacts for hikers. No impairment. **Objective met.**	Mostly positive moderate direct impacts for hiking. No impairment. **Objective met.**
ARCHEO-LOGICAL RESOURCES	Moderate direct and indirect impacts; no impairment. **Objective met.**	Moderate direct and indirect impacts; no impairment. **Objective met.**	Minor to moderate direct and indirect impacts to individual sites and/or overall archeological district; no impairment. **Objective met.**	Negligible direct and indirect impacts. No impairment. **Objective met.**
RIPARIAN/ WETLAND ECOSYSTEM				
• Functioning condition	Minor to moderate direct impact; risk of major indirect impact from flooding; **impairment likely. Objective not met.**	Minor direct impact; risk of major indirect impact from flooding; **impairment likely. Objective not met.**	Moderate direct impact; risk of major indirect impact from flooding; **impairment likely. Objective not met.**	Major direct beneficial effect.; risk of major indirect impact abates; no impairment. **Objective met.**
• Area (acreage) of Riparian/ Wetland Disturbance	Minor direct impact, risk of major indirect impact; **impairment likely. Objective not met.**	Minor direct impact, risk of major indirect impact; **impairment likely. Objective not met.**	Minor direct adverse impact at first, moving to minor direct beneficial impact. Risk of major indirect impact; **impairment likely. Objective not met.**	Moderate direct beneficial effect; no impairment. **Objective met.**
• Water Quality	Moderate direct impact, risk of major indirect impacts; **impairment likely. Objective not met.**	Minor to moderate direct beneficial impact; risk of major indirect impacts; **impairment likely. Objective not met.**	Moderate direct impact; risk of major indirect impact; **impairment likely. Objective not met.**	Moderate direct beneficial effect; no impairment. **Objective met.**
WILDERNESS	Negligible effect; no impairment. **Objective met.**	Negligible effect; no impairment. **Objective met.**	Moderate effects; no impairment. **Objective met.**	Minor beneficial effects; no impairment. **Objective met.**

2.2 Alternative Comparison

Management common to all alternatives

Under all altematives, day hiking and backpack camping in the Salt Creek/Horse Canyon backcountry zone (which includes the Peekaboo to Angel Arch section), and vehicle camping at Peekaboo, would continue under existing regulations and limits. Pack/saddle stock use would be permitted on the Salt Creek road, under the limits and provisions in the Canyonlands Backcountry Management Plan (NPS 1995). The authorization of vehicle travel and stock use on Salt Creek road above Peekaboo is addressed by these altematives. All other provisions of the Canyonlands Backcountry Management Plan would remain in effect.

Mitigation

The CEQ definition of mitigation (40 CFR 1508.20) includes (a) avoiding the impact altogether by not taking a certain action or parts of an action, and (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation. The four altematives analyzed in this EA use one or both of these methods, in the aim of mitigating the impacts of vehicle travel in Salt Creek, thus each could be considered a mitigation measure in itself.

Under all four altematives, resource conditions would be closely monitored based on the impact evaluation criteria described under the impact topics. If unacceptable adverse impacts occur in the Peekaboo to Angel Arch reach of Salt Creek following implementation of the alternative selected, additional management action would be taken to reduce impacts.

Existing Canyonlands and NPS rules, regulations and policies are intended to mitigate impacts to various resources from backcountry recreation. These are incorporated here by reference. The Canyonlands Backcountry Management Plan includes provisions affecting water quality and quantity, wildlife, human waste, stock, and other impacts applicable to Salt Creek use. The BMP also established limits on the numbers of people and vehicles in backcountry zones and locations, including Salt Creek. The Canyonlands Cultural Site Information Disclosure Policy (Superintendents Directive 1993 H-1) provides some protection for cultural resources. Regulations in 36 CFR part 2 provide additional legal protection for natural and cultural resources.

Mitigation actions would include clearly delineating the road and/or trail to guide visitors and discourage creation of multiple roads and/or trails. If pedestrians or erosional processes are found to be displacing archeological deposits, then mitigation actions would be taken, which may include:

- relocating and clearly designating pedestrian trails,
- removing social trails,
- constructing boardwalks over archeological deposits,
- encapsulation of archeological deposits by covering impacted areas with fill material, or
- a combination of the above.

The NPS has designated protected activity centers (PACs) around all known territories of Mexican spotted owl, a federally-listed threatened species, including those in or near Salt Creek Canyon. A PAC is a management tool to minimize disturbance and assure consideration of owl

habitat needs. Owl territories identified during research in the mid-1990's are being re-inventoried, and beginning in 2002 a comprehensive re-survey of the entire park will be undertaken to determine the current status of the Mexican spotted owl population.

Mitigation actions for archeological resources would include:

- Baseline condition assessments for all sites considered archeological resources under either the Archaeological Resources Protection Act or the National Historic Preservation Act
- For each site, development of a monitoring program and inspection schedule, to periodically reassess site conditions and evidence of disturbance or deterioration.

Excavation and recovery of archeological materials and information is a mitigation strategy. A reduction in the estimated intensity of an impact as a result of mitigation is acceptable under the National Environmental Policy Act (NEPA). Under Section 106 of the National Historic Preservation Act (which pertains to cultural resources), the intensity of an adverse effect may be mitigated (by scientific excavation and data recovery), but the characterization of the effect remains adverse.

2.2.1 Alternative A (No Action): Vehicle access all year as weather permits; daily limits on numbers of vehicles through permit system

The existing Salt Creek four-wheel-drive road, from Peekaboo to near Angel Arch, would be managed as described in the 1995 Canyonlands/Orange Cliffs Backcountry Management Plan (BMP). As described in the BMP, the road section from Peekaboo to Angel Arch would be included under the provisions currently in effect for the road section from Peekaboo to the gate near Cave Spring, as well as Horse Canyon. The Peekaboo to Angel Arch section, as the others, would be a Class IV primitive park road, defined by NPS Park Road Standards (1984) as:

> Roads which provide circulation through remote areas and/or access to primitive campgrounds and undeveloped areas. These roads frequently have no minimum design standards and their use may be limited to specially equipped vehicles.

The existing unimproved road would continue to be used in its current general alignment. The road would receive occasional maintenance, only to the level required to keep it passable to high-clearance four-wheel-drive vehicles without use of winches. It may occasionally be impassable as a result of weather and/or streamflow, particularly in winter when the creek is usually frozen for several weeks.

The number of vehicles permitted to travel the road each day would continue to be limited. Federal regulations require that vehicles (including motorcycles) travelling park roads must be state-licensed for highway travel ("street-legal"). Vehicle travel off the road, as well as all-terrain vehicles (ATVs) would be prohibited. Backcountry permits would be required for all vehicle, pack stock, and bicycle use, and all overnight backpacking use.

Access beyond the gate, enabling travel in Salt Creek or Horse Canyon or both, would be subject to the following day-use limits :

Noncommercial motor vehicles	10 permits (1 vehicle per permit)
Commercial motor vehicles	2 permits (1 vehicle per permit)
Bicycles (noncommercial or commercial):	7 bicycles (1 or more permits)
Pack or saddle stock	7 animals (1 or more permits)

Visitors with backcountry permits for overnight camping at Peekaboo, or for backpacking in the Salt Creek/Horse Canyon or Upper Salt Creek zones, would be subject to the existing provisions and limits for those activities. Ovemight parking would only be permitted at the Peekaboo camp or at the Upper Salt Creek trailhead parking (the former Angel Arch camp).

2.2.2 Alternative B: Vehicle access part-year, daily limits on numbers of vehicles through permit system

This alternative would seek to mitigate the impacts of alternative A, by reducing the annual duration of vehicle travel and limiting vehicle travel to a period when some resources may be less vulnerable. Vehicle travel would be permitted each year from October 1 until ice makes the creek impassable, generally in late November or December. The open period would extend no later than January 31 of the following year. Vehicles would travel the same route as in alternative A. For the remainder of the year, vehicles would be prohibited above Peekaboo.

During the vehicle travel period, the vehicle-related provisions of alternative A would apply, including the road classification (class IV primitive park road), maintenance levels, vehicle requirements, and limits on daily numbers of vehicles.

2.2.3 Alternative C: Road realignment, vehicle access all year as weather permits, daily limits on numbers of vehicles through permit system

This alternative would seek to mitigate the impacts of alternative A, by relocating portions of the four-wheel-drive road outside of the streambed and riparian area, where possible. New road sections would generally be located on terraces two to thirty feet above the current stream channel, generally corresponding to the "cottonwood terrace" identified by Webb (2001) as one of two terraces where relocation might be feasible. The benches are fairly flat but would often require a steep climb, as much as 30 feet above the creek, and/or significant excavation to reduce the slope of the climb. The climbs would be across loose sand; mitigation would include surfacing or stabilization to reduce erosion and maintain passability for vehicles. In some cases the relocated segments would also cross short sections of currently undisturbed riparian vegetation, in order to avoid longer or wetter riparian or streambed sections.

An estimated 30 percent of the total existing road length in the streambed or riparian area would be relocated, reducing the total road length in the riparian area from 4.3 miles to about 3 miles, out of the total 7.2 road miles. An estimated 15 percent of this mileage would be new road created in riparian area (0.5 miles); the remainder would be existing road that would continue to be used in riparian area. The non-riparian portion of new alignment would traverse an estimated 2.3 miles of upland.

The road classification (class IV primitive park road), vehicle requirements, maintenance level, and daily limits would be as described in alternative A.

2.2.4 Alternative D (Preferred Alternative): Vehicles prohibited all year

This alternative would seek to mitigate the impacts of alternative A, by prohibiting vehicles above Peekaboo year-round. Hiking and pack and saddle stock would continue to be permitted above Peekaboo, under the existing provisions of the backcountry management plan.

2.3 Alternatives Considered but Eliminated from Further Study

2.3.1 Unlimited vehicle use

The lower Salt Creek road section (Cave Spring to Peekaboo), providing access to the Angel Arch section, has a daily vehicle limit in place which was established in the BMP. Consequently, implementing an unlimited vehicle use alternative above Peekaboo would not be possible unless the existing limits were removed on the lower section, which is beyond the scope of this EA.

2.3.2 New four-wheel-drive road outside Salt Creek Canyon

Potential alternative routes outside of Salt Creek Canyon would cross land recommended by the NPS and the Secretary of Interior for wilderness designation (NPS 1974). NPS policy is that lands recommended for wilderness are to be managed to maintain their wilderness characteristics until Congress acts on the recommendations. Thus construction of such a road would likely require legislative action and/or a revision to the Canyonlands Wilderness Recommendation and General Management Plan. Such alternative routes would also be outside the geographic scope of this EA. Consequently, this alternative was eliminated from further analysis.

2.3.3 Allow vehicles to drive part way between Peekaboo and Angel Arch

A suggestion from the public was to allow vehicles to drive part of the way between Peekaboo and Angel Arch, to some point within the range of a shorter day hike to Angel Arch (4-8 miles roundtrip). Sections of stream channel or riparian habitat crossed by the road are relatively evenly spaced along the reach from Peekaboo to the Angel Arch junction, so there is not a point above Peekaboo to which vehicle travel could be extended but terminated before it reached most of the riparian impact area. Hence this alternative was eliminated from further study.

2.4 Environmentally Preferred Alternative

The Council on Environmental Quality (CEQ), in guidance on implementation of the National Environmental Policy Act (NEPA) regulations, defines the environmentally preferred alternative as:

> the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources (46 Federal Register 55:18026-18038, March 23,1981).

Section 101(a) of NEPA recognizes the importance of environmental quality to the overall welfare of man, and declares a continuing policy to promote conditions under which man and nature can exist in productive harmony. Section 101(b) establishes a continuing responsibility for the federal

government to improve and coordinate federal plans, functions, programs, and resources to the end that the Nation may:

1. fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. assure for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings;
3. attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
4. preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
5. achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
6. enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

According to NPS policy (Director's Order 12, 2001), the environmentally preferred alternative is the alternative that will promote the national environmental policy expressed in NEPA Section 101(b), which includes alternatives that accomplish the goals from this section (listed above).

CEQ regulations (40 CFR 1502.2(d)) require that NEPA documents include a section stating how each alternative analyzed in detail would or would not achieve the requirements of NEPA sections 101 and 102(1), and other environmental laws and policies. In the park service, this requirement is met by 1) disclosing how each alternative, one of which is identified as the environmentally preferred, meets the goals of section 101(b) of NEPA (above); and 2) any inconsistencies between the alternatives analyzed in detail and other environmental laws and policies.

Alternatives A and C, which would permit year-round vehicle access on the current road or a partly relocated road, as well as hiking and stock access, would allow the widest range of uses and variety of individual choice, but would also cause the highest level of environmental degradation, thus failing to accomplish goals 1 through 6. These alternatives would provide the least protection to natural and cultural resources, and cause the most damage to the biological and physical environment. These alternatives would be inconsistent with the NPS Organic Act, by causing impairment of park resources or values.

Alternative B, which would permit vehicle access for part of the year on the current road, as well as hiking and stock access, would be intermediate between alternatives A and C and alternative D in range of uses as well as environmental degradation. It would thus be less effective than alternative D in accomplishing goals 1 through 6, but more effective than alternatives A and C in accomplishing these goals. Alternative B would be intermediate in protection of natural and cultural resources, and in damage to the biological and physical environment. This alternative would be inconsistent with the NPS Organic Act, by causing impairment of park resources or values.

Alternative D is the "Environmentally Preferred Alternative" under CEQ guidelines and NPS policy. Alternative D, which allows hiking and stock access but prohibits vehicle access, would provide the most protection to cultural and natural resources, and would cause the least damage to the biological and physical environment, by removing the direct impact caused by vehicle use, and by reducing the overall disturbance caused by presence of vehicles and the higher levels of human use facilitated by vehicle access. Alternative D would have either a positive or neutral

effect on goals 1 through 6 of NEPA section 101(b), by meeting NPS trustee responsibilities to assure future generations of opportunities for beneficial uses of the environment, while preserving resources and balancing use. This alternative would not be inconsistent with any other environmental laws or policies.

3. AFFECTED ENVIRONMENT

3.1 Introduction

Salt Creek flows about 5.5 miles from its headwaters on the north slope of the Abajo Mountains to its entry into Canyonlands National Park at the south park boundary. From the park boundary the main stem of the creek continues northerly about 34.5 miles to its confluence with the Colorado River. Tributaries include the West Fork, Horse Canyon, and numerous unnamed side canyons. The creek supports the most extensive riparian/wetland ecosystem in the park, other than the Green and Colorado Rivers. A primitive four-wheel-drive road runs along and in parts of the streambed.

The scope of this EA is limited to the section of Salt Creek and the Angel Arch side canyon that is the subject of continuing litigation, which extends from Peekaboo campsite to Angel Arch. However, in order to comparatively evaluate the effects of vehicle traffic, two other sections of Salt Creek are also examined; the section above Angel Arch turnoff and the section from Cave Spring to Peekaboo.

- Cave Spring to Peekaboo: This section continues to be traveled by motorized vehicles. It includes approximately 3.6 stream miles; the road is in the creek bed for about 2.3 of these miles (64 percent of this section of creek).
- Peekaboo to Angel Arch junction: Motor vehicles were permitted to travel this section until summer 1998, when they were prohibited by court order. This section includes about 8.6 creek miles, and the jeep road is in the stream bed for about 1.2 of these miles (14 percent of this section of creek).
- Above Angel Arch turnoff: The section from about a half-mile above Angel Arch turnoff to the Upper Jump (about 4.4 miles) has not had vehicle traffic since the mid-1970s. The section above the Upper Jump (about 6.8 miles) has probably never had vehicle traffic.

From Peekaboo to the Angel Arch turnoff, the length of existing jeep road within the riparian area is estimated at approximately 22,600 linear feet (4.3 miles). Assuming an eleven-foot wide travelway, this results in a disturbed surface area of approximately 5.7 acres within the riparian zone between Peekaboo and Angel Arch, which would likely be colonized by riparian vegetation if not traveled by vehicles.

Geology and Topography

Canyonlands National Park lies within the vast interior erosional basin formed on the uplifted Colorado Plateau. The carved and eroded basin is characterized by deeply entrenched rivers

and intermittent streams that have created a labyrinth of canyons on three distinct levels within the park area. The region as a whole is a rugged, deeply eroded desert. Red sandstone, carved into fantastic shapes and deep canyons, dominates the landscape.

Salt Creek drains the largest watershed in the southeastern part of the park, an intricate network of canyons in the Permian-age Cedar Mesa Sandstone formation. The creek begins above 8000 feet on the north side of the Abajo Mountains, one of only two streams in the park with high elevation headwaters (other than the Green and Colorado Rivers; the other stream, Indian Creek, is only inside the park for the last mile of its length). The watershed is dominated by impermeable surfaces and runoff-producing characteristics, with over 60 percent of the area covered by uplands with exposed bedrock or shallow rocky soils (USSCS 1991). Valley bottoms have deep alluvial and eolian sand, into which the stream channel is incised. The watershed area includes approximately 76 square miles above the Horse Canyon junction.

Climate

Climate is semi-arid in upper elevations and arid in lower elevations. Average annual precipitation is approximately 8.5 inches in the Needles area, but 15 to 20 inches or more in the upper reaches of the watershed in the Abajo Mountains. The wettest period is July through October, which receives about 45 percent of annual precipitation. June is generally the driest month, but intense rainstorms may occur in any month between spring and fall. Precipitation at the Needles is dominated by relatively brief, heavy downpours, which exceed the capacity of vegetation and soil to intercept and infiltrate. Storms are often very localized, with one watershed receiving a downpour while a neighboring one is virtually dry. The combination of climate and watershed conditions results in rapid overland runoff and flash floods.

Rainfall amounts for various recurrence intervals are estimated by the National Oceanic and Atmosperic Administration (NOAA 1973):

- Maximum 24 hour rainfall, 5 year recurrence: upper elevations, 1.6 inches; lower elevations, 1.4 inches
- Maximum 24 hour rainfall, 10 year recurrence: upper elevations, 2 inches; lower elevations, 1.8 inches
- Maximum 24 hour rainfall, 25 year recurrence: upper elevations, 2.4 inches; lower elevations, 2.2 inches

Actual precipitation records indicates somewhat lower rainfall amounts for the Needles weather station than these estimates, with 1.56 inches the highest recorded one-day rainfall between 1965 and 2000, but localized variability from storms may account for this difference. A USGS field research team recorded 1.5 inches of rain in Salt Creek Canyon, about four miles from the Needles weather station, on a day in August 2001 when the Needles station recorded one inch of rain.

3.2 Impact Topics

3.2.1 Threatened, Endangered and Sensitive Species

One federally listed threatened species is present in Salt Creek Canyon and vicinity. Mexican spotted owls (*Strix occidentalis lucida)* nest in the area, and the canyons are designated critical habitat for the owls. Bald eagles (*Haliaeetus leucocephalus*), also listed as threatened, have been recorded in the general vicinity, but have not been noted in Salt Creek Canyon. The endangered southwestern willow flycatcher *(Empidonax traillii extimus)* is thought to use the river corridors in Canyonlands National Park as a migration route, but surveys have revealed no nesting activity, and none have been found in the Salt Creek area. Other federally listed species found in the Green and Colorado Rivers but considered to be beyond the range of influence of this plan are: humpback chub *(Gila cypha)*, Colorado pikeminnow (*Ptychocheilus lucius),* razorback sucker *(Xyrauchen texanus)*, and bonytail *(Gila elegans).*

In addition to federally listed species protected by the Endangered Species Act, the state of Utah has developed a list of "sensitive" species. The only state-listed species known to occur in Salt Creek Canyon are the peregrine falcon (*Falco peregrinus anatum*), the blue grosbeak (*Guiraca caerulea*), the Lewis's woodpecker (M*alanerpes lewis)* and the common yellowthroat (*Geothlypis trichas*)

No state or federally listed plant species are known to occur in the plan area.

3.2.1.1 Mexican Spotted Owl

The Mexican spotted owl (MSO) was placed on the federal T&E list as a threatened species in 1993. In March, 2001 critical habitat was designated. This habitat designation includes all of the land within Canyonlands National Park having suitable habitat characteristics (primary constituent elements). The area in and around Salt Creek Canyon has these habitat characteristics, and is therefore designated critical habitat for the MSO. In addition, the owl is known to nest in a number of nearby canyons, where Protected Activity Centers (PAC's) have been established as a management tool to minimize disturbance and assure consideration of owl habitat needs.

The designation of critical habitat by FWS provided the opportunity to review NPS activities under the existing Backcountry Management Plan (BMP) to assure continued compliance with recovery plan recommendations and agency responsibilities under the ESA. Guidance provided by the December, 1995 Recovery Plan for the Mexican Spotted Owl, as well as criteria outlined in the Final Rule designating critical habitat, were considered in arriving at a determination of effect. By a memorandum dated May 25, 2001, the NPS provided the U.S. Fish and Wildlife Service Utah Field Office with a finding that the level and type of backcountry use prescribed by the 1995 Backcountry Management Plan would not destroy or adversely modify designated critical habitat

for the Mexican spotted owl. The FWS concurred. This finding is consistent with the March, 2001 critical habitat designation, (FR/vol. 66, No. 22/p. 8546):

> Actions not likely to destroy or adversely modify critical habitat include activities that are implemented in compliance with the Recovery Plan, such as...most recreational activities including hiking, camping,... off road vehicle use, and various activities associated with nature appreciation.

In early 1997, the NPS designated protected activity centers (PAC's) around all known spotted owl territories in Canyonlands National Park, and generated a GIS map and data layer for use in assessing ongoing or proposed activities occurring in owl habitat. PAC's were established according to USFWS guidelines appearing in the 1995 recovery plan, and were based on data developed during extensive surveys of the area in the mid-1990's. (Willey, 1998). FWS recommends a minimum PAC size of 600 acres (USDI Fish and Wildlife Service, 1995); the smallest designated in Canyonlands is 745 acres, and the largest nearly 1600 acres. They are delineated to include as much owl foraging area as practical, taking into consideration the actual topography and likely habitat in the area. Nine of the 22 PAC"S designated in Canyonlands National Park are in the general vicinity of Salt Creek Canyon, but none are in the main canyon.

All spotted owl territories identified during research in the mid-1990's are being re-inventoried, and beginning in 2002 a comprehensive re-survey of the entire park will be undertaken to determine the current status of the Mexican spotted owl population.

The NPS continues to consult with the FWS on any action that may affect the Mexican spotted owl. Project analyses and conservation planning for the owl will continue to incorporate the best available biological and behavioral information

3.2.1.2 Peregrine Falcons

The peregrine falcon was removed from the federal list of T&E species in 1999, but remains on the Utah Sensitive Species list. A database representing years of monitoring information is available for peregrine falcons in Canyonlands National Park, and they are known to nest in side canyons around Salt Creek Canyon.

3.2.1.3 Other State-listed Birds

Three other state-listed sensitive species, the common yellowthroat, the blue grosbeak, and the Lewis's Woodpecker are found in Salt Creek Canyon. The common yellowthroat and the blue grosbeak are known to nest in the canyon or the surrounding area.

3.2.2 Wildlife

The riparian zone associated with Salt Creek supports the richest assemblage of vertebrate wildlife species and individuals anywhere in the park, outside of the Colorado and Green River corridors. The drainage provides a protected corridor link to the montane ecosystem of the Abajo Mountains, and represents a rare year-around water source in an arid environment.

NPS regulations provide protection to wildlife from feeding, touching, teasing, frightening, or intentional disturbing of nesting, breeding, or other activities (36 CFR 2.2). Policy requires consideration of impacts to wildlife in planning and conducting park management activities, including visitor use management. Executive Order 13186 requires Federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to consult with the FWS.

3.2.2.1 Birds

Monitoring results indicate that Salt Creek Canyon has the highest species richness and density of any of the bird monitoring sites in the four parks of the Southeast Utah Group (Canyonlands and Arches National Parks, and Natural Bridges and Hovenweep National Monuments). Monitoring is conducted annually in Salt Creek Canyon during the breeding season, and in 2001 35 species were detected. (Daw 2001).

3.2.2.2 Amphibians and Reptiles

Amphibians found in Salt Creek Canyon include the tiger salamander *(Ambystoma tigrinum)*, spadefoot toad *(Spea sp.)*, red-spotted toad *(Bufo punctatus)*, and Woodhouse toad *(Bufo woodhousii)*.

In recent decades there has been much concern over population declines in frog and toad species worldwide (Blaustein and Wake 1990, Wyman 1990). Several frog and toad species in the western United States have suffered serious declines. Speculation on causes ranges from acid precipitation and increased ultraviolet radiation to non-native predators and diseases. However, habitat loss, fragmentation, and degradation are the most widespread and readily-identifiable causes, both in the United States (Corn 1993, Bury et al. 1980) and in other areas of the world (Johnson 1992, Vial and Saylor 1993). In the Southwest, 10 amphibian species have suffered declines of varying degree (one species to the point of extirpation, two others to near-extirpation; Corn 1993, Vial and Saylor 1993). Most of these species are frogs (genus *Rana*) and toads (genus *Bufo*).

Although the role of amphibians in ecosystems is not well known, they are sensitive to a number of environmental perturbations and therefore make good candidates for monitoring of ecosystem health. Riparian ecosystems in arid and semi-arid environments are recognized as having very high biodiversity relative to the surrounding landscape; perhaps up to 90% of organisms in an area are either found in or use riparian areas. Arid and semi-arid environments have the greatest amphibian diversity in riparian zones. Amphibians require both aquatic and terrestrial habitats, are a major predator of many invertebrates, and are sensitive to relatively minor environmental

changes. As such, frog and toad populations may be good indicators of ecosystem conditions because they integrate across so many environmental variables.

Reptiles found or likely to be found in the Salt Creek Canyon include the collared lizard *(Crotaphytus collaris),* striped whiptail lizard *(Cnemidophorus velox)*, eastern fence lizard *(Sceloporus undulatus elongatus),* western whiptail lizard *(Cnemidophorus tigris septentrionalis)*, gopher snake *(Pituophis melanoleucus deserticola)*, wandering garter snake *(Thamnophis elegans vagrans),* and the midget faded rattlesnake *(Crotalus viridis).* Little is known of the distribution or density of reptiles in the area.

3.2.2.3 Large Mammals

The connection of Salt Creek drainage with the Abajo Mountains provides an important corridor for movement of large mammals between the two ecosystems. Mountain lions (*Felis concolor)*, mule deer *(Odocoileus hemionus)*, black bears *(Ursus americanus),* and a number of species of smaller mammals are known to frequent the area. The small black bear population in the Abajos faces a number of threats, and Salt Creek Canyon provides an important refuge and emergency food supply for these bears during periods of stress (Mattson 2001). Desert bighorn sheep *(Ovis canadensis nelsoni)* frequent the cliffs and mesas in the area, but seldom use Salt Creek or similar canyons due to habitat preferences.

3.2.2.4 Other Mammals

Among the diverse mammal species that use the Salt Creek Canyon area are the coyote *(Canis latrans)*, canyon mouse *(Peromyscus crinitus)*, deer mouse (*P. maniculatus*), pinyon mouse *(P. truei)*, desert woodrat *(Neotoma lepida)*, porcupine *(Erithizon dorsatum)*, blacktailed jackrabbit, *(Lepus americanus),* and desert cottontail *(Sylvilagus auduboni).* Numerous bat species are also found in the area, although little is known about their distribution and abundance.

3.2.3 Natural Soundscape

NPS management policies require preservation of park natural soundscapes to the greatest extent possible. Natural soundscapes are defined as "the aggregate of all the natural sounds that occur in parks, together with the physical capacity for transmitting natural sounds." The policy further directs that "The Service will restore degraded soundscapes to the natural condition wherever possible, and will protect natural soundscapes from degradation due to noise (undesirable human-caused sound)." It is recognized that "The frequencies, magnitudes, and durations of human-caused sound considered acceptable will vary throughout the park, being generally greater in developed areas and generally lesser in undeveloped areas." (NPS Management Policies 2001). Canyonlands National Park as a whole has a natural soundscape with a very low occurrence of intrusive human-caused noise (Gdula 1998).

3.2.4 Recreational Experience

Visitors come to Canyonlands National Park for many different reasons, and with a variety of expectations. It is difficult to attribute any single purpose for a park visit, but most come to experience the scenic beauty of the park, and to engage in some form of recreation. Recreation is a highly individualized activity, and can vary from reading a book in the quiet shade of a trackless canyon, to driving a rough road in a four-wheel drive vehicle. Both of these activities, and most others, assume some level of accessibility to park resources. The impact topic of recreational experience is intended to represent the effect of various alternatives on the general accessibility of the unique natural and cultural resources of Salt Creek Canyon, and on the popular activities of day hiking and backpacking.

3.2.4.1 Accessibility

Plans to regulate motor vehicle access to scenic areas previously open to motorized travel raise the question of accessibility, particularly for those physically challenged due to age or disability. One of the major destination points for four-wheel drive users and hikers in Salt Creek Canyon is the unique geologic formation called Angel Arch. Many visitors not willing or able to undertake a multi-day hike to view this and other features of Salt Creek Canyon, have expressed concern about general access to the canyon should vehicle use be curtailed.

Four-wheel drive use on backcountry roads is regulated by the 1995 Backcountry Management Plan. In 1994, the last year of unlimited vehicle access prior to implementation of the BCMP permit system, approximately 2700 vehicles used the Salt Creek Canyon road.

3.2.4.2 Hiking/Backpacking

Canyonlands NP contains over 158 miles of hiking trails, and over 150 miles of four-wheel drive roads are available for hikers as well. Hiking, overnight camping, and other backcountry activities are regulated by the 1995 Backcountry Management Plan. Despite the significant increase in backcountry use in Canyonlands National Park over the past 15 years, it still offers a quality backcountry experience for those looking for a daylong or multi-day hiking trip on developed trails in a wilderness setting, with the likelihood of seeing a relatively low number of other hikers or campers during the course of the trip. Salt Creek Canyon is especially popular since the presence of water there permits a multi-day hike without carrying in many gallons of water. In the year 2001, approximately 1500 people obtained permits for overnight use of Salt Creek Canyon and the immediate area.

Backcountry roads and trails abound in the region outside the park, although hikers often share them with four-wheel drive and off-road motorized vehicles.

3.2.5 Archeological Resources

The National Historic Preservation Act, as amended in 1992 (16 USC 470 et seq.), the National Environmental Policy Act, and NPS Management Policies (2001) require the consideration of effects on cultural resources, including those listed on or eligible for listing on the National Register of Historic Places.

The alternatives described in this document are subject to Section 106 of the National Historic Preservation Act under the terms of the 1995 programmatic agreement among the National Park Service, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers. This EA will be submitted to the State Historic Preservation Officer (SHPO) for review and comment.

Under Section 106 of the National Historic Preservation Act of 1966, only historic resources that are eligible for or are listed on the National Register of Historic Places are analyzed for impacts. An impact, or effect, to a property occurs if a proposed action would alter in any way the characteristics that qualify it for inclusion on the register. Detailed identification of cultural properties pertaining to Salt Creek Road, Canyonlands National Park, are presented in *An Archeological Inventory of the Salt Creek Road, Salt Creek Archeological District, Needles District of Canyonlands National Park* (Brunnemann et al. 2001). Recent archeological information pertaining to the Needles District and Salt Creek Canyon can also be found in *Holocene Archeology Near Squaw Butte, Canyonlands National Park, Utah* by Betsy L. Tipps (1995); and *Cultural Resource Inventory and Testing in the Salt Creek Pocket and Devils Lane Areas, Needles District, Canyonlands National Park, Utah* (Tipps and Hewitt 1989).

Salt Creek Archeological District was listed on the National Register of Historic Places in 1974. In 1989 the Utah State Historic Preservation Officer concurred with a Determination of Eligibility for expanding Salt Creek Archeological District. The most important factor in National Register eligibility determination was site density. "In contrast to the remainder of the area within Canyonlands National Park, the upper two-thirds of Salt Creek, together with its tributaries, offered aboriginal peoples fairly accessible, well-watered, arable land. For this reason, the area contains by far the greatest concentration of archeological sites and structures within the park" (National Register Nomination 1974: 2). The National Register nomination identifies the significance of Salt Creek District to be the "distinct and complete ecosystem surrounded and cut off by physical barriers" (1974: 4), providing a critical scientific landscape for examining regional differences within the prehistoric cultural record of the greater American Southwest.

In May 2001, a team of National Park Service (NPS) archeologists, from the NPS Intermountain Support Office in Santa Fe and Canyonlands National Park, implemented a systematic archeological survey along the segment of Salt Creek Road between Peekaboo Campsite and Angel Arch, in Salt Creek Archeological District, Canyonlands National Park (Brunnemann et al. 2001). The purpose of this survey was to identify cultural properties directly within the four-wheel drive road that extends up Salt Creek Canyon. This archeological survey provides 100 percent inventory for cultural resources in this segment of Salt Creek Road.

During the 2001 survey, a total of six archeological sites were recorded in Salt Creek Road between Peekaboo Campsite and the turnoff to Angel Arch. All six archeological sites are within the area defined as Salt Creek Archeological District, which was listed on the National Register of

Historic Places as an archeological district in 1974. The team further recommended that all six archeological sites are eligible for nomination to the National Register of Historic Places under Criterion D (36 CFR 60.4 (d)). Under this criterion for evaluation in 36 CFR 60.4 (d):

> The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association [and]...have yielded, or may be likely to yield, information important in prehistory or history.

Impacts to these archeological sites include Salt Creek Road, natural erosion, and visitation. Short social trails between the road and archeological sites are visible. Archeological sites in Salt Creek Road have been visited and used for camping in the past, as is evidenced by deposits of modern charcoal, footprints, and social trails. Camping and visitation does not appear to have physically damaged the artifacts or facilitated additional erosion, but archeological deposits within some shelters appear to have been moved. The Code of Federal Regulations 36 CFR 2.1 (a)(5) states that archaeological and cultural sites may not be entered, altered, or damaged by visitors. Although this means visitors may not go inside archeological structures, human-made enclosures, or archeological features, visitors may cross archeological sites to see features of interest. (See Canyonlands Natural Park and Orange Cliffs Unit of Glen Canyon National Recreation Area, Backcountry Management Plan, 1995: 21).

In this EA, the archeological "condition" of a site is derived from definitions set forth in the current NPS Resources Management Plan (RMP) condition definitions for archeological resources recorded in the NPS Archeological Sites Management Information System (ASMIS). The archeological site condition determinations made during the survey of Salt Creek Road in May 2001, and presented in this document, were recorded during the period when Salt Creek Road had been closed to vehicle access. Herein, site condition refers to the physical stability of the site and its potential for deterioration over time, at the time of inspection.

Three of these sites are prehistoric lithic quarrying areas (42SA24649, 42SA24650, and 42SA24651), one is a historic Euro-American corral with a possible prehistoric component (52SA24652), and two are prehistoric flaked stone artifact scatters (42SA24653 and 42SA24654). These prehistoric lithic sites may be of Archaic or ancestral Puebloan cultural affiliation. The first four (sites 42SA24649 through 42SA24652) have boundaries that extend beyond the immediate roadway. The latter two (42SA24653 and 42SA24654) appear to be in the process of being uncovered as vehicle traffic deepens the roadbed. No artifacts were visible at these last two sites beyond the confines of the road itself. Archeological testing would be necessary to determine the true extent of these sites.

Site 42SA24649 Lithic Quarry Area

This site extends from the bank of Salt Creek up a sandy slope to the base of the sandstone cliffs that form the walls of Salt Creek Canyon. Midway between the creek and the sandstone wall is a bench in which brown chert nodules are found and were mined prehistorically by excavating them from an exposed stratum. Two rock shelters are also present: one in the base of the sandstone wall, and the other under a large sandstone boulder. Although the shelters show no immediate evidence of habitation (smoke blackening on the alcove roofs, for example), their location close to raw materials and water may have contributed to the attractiveness of the location. The lower portion of the site includes an area where the bed of the Salt Creek Road changes from sandy soil to bedrock.

The National Park Service believes this site is in good physical condition and has the potential to yield archeological information. The main impact is Salt Creek Road, which runs through the southern portion of the site. The road has promoted erosion of prehistoric lithic materials. Down-cutting resulting from road use has steepened slopes, thereby increasing the rapidity of erosion of sediments and archeological materials when precipitation produces runoff. Artifacts washed into the roadbed display evidence of having been crushed between the bedrock and vehicle tires. Natural erosion of the site is not severe, but there are a number of shallow drainages running from the sandstone canyon walls through the site and across the road towards Salt Creek. There is evidence of visitor use in the form of social trails leading to the rock shelters and quarry areas. Use of the larger rock shelter for camping is suggested by pieces of modern charcoal.

The site is eligible for nomination to the National Register under criterion D (36 CFR 60.4 (d)) because the site has yielded, and is considered likely to yield, information important in prehistory or history. Specifically, the site has potential to yield information on prehistoric resource procurement and use during the prehistoric occupation of the region.

Site 42SA24650 Lithic Quarry Area

The site is composed of a rock shelter in a bench above Salt Creek, a lithic quarry area, and a large lithic scatter. The rock shelter ground surface has no visible features, but there are flaked stone artifacts in the shelter fill, suggesting cultural depth below ground surface. In the surrounding area there is evidence of lithic material reduction, including many tested cobbles and flakes bearing cortex. The lithic scatter is more diffuse in the west end of the rock shelter, but relatively dense throughout the rest of the site (beyond the rock shelter). Given the large extent of the site and recording time constraints, the exact boundaries of the site have not been established.

The National Park Service believes this site is in good physical condition and has the potential to yield archeological information. Erosion is minor, as the surrounding topography limits sheetwash and the shelter itself is well protected. The lack of natural erosion has contributed to the stability of the archeological deposits and slowed the progress of artifacts being washed into the roadbed. The main impact is Salt Creek Road, which runs through the southern portion of the site. The road has promoted erosion of prehistoric lithic materials. Down-cutting resulting from road use has steepened slopes, thereby increasing the rapidity of erosion of sediments and archeological materials when precipitation produces runoff. Artifacts washed into the roadbed by these events display evidence of having been crushed between the bedrock and vehicle tires. The rock shelter is large, and has been visited and used for camping in the past, as is evidenced by deposits of modern charcoal, footprints, and a lack of vegetation within its confines. Camping does not appear to have physically damaged the artifacts, but the archeological deposits within the shelter have been disturbed. Short social trails between the road and shelter are visible.

The site is eligible for nomination to the National Register under criterion D (36 CFR 60.4 (d)) because the site has yielded, and is considered likely to yield information important in prehistory or history. Specifically, the site has potential to yield information on prehistoric resource procurement and use during the prehistoric occupation of the region.

Site 42SA24651 Lithic Scatter

Site 42SA24651 is a lithic reduction site containing cores, flakes, thinning flakes, and bifaces. The site consists of a lithic scatter and three low overhangs that appear too small to serve as habitations but could have been used as seasonal or camp shelters. Because of the proximity of

the lithic materials forming sites 42SA24651 and 42SA24650 and their common geologic origin, the distribution of lithic materials forming these sites may be continuous. Given the large size of both sites, further mapping to clarify the exact boundaries is recommended.

The National Park Service believes this site is in fair physical condition and has the potential to yield archeological information. The primary impact to the site is Salt Creek Road, which curves through the eastern and southern portions of the site. Because of its downward slope, in this portion of the site, the road has accelerated surface erosion and is displacing artifacts. Although the roadbed is particularly sandy and deep, and while the artifacts found in the roadbed do not display as much physical damage as artifacts found on bedrock portions of the road, the road is cutting through cultural deposits. Visitor use is light as evidenced by footprints, and social trails between the road and shelters. Artifacts have been moved by visitors to the larger rock shelter. Natural erosion is light across the majority of the site.

The site is eligible for nomination to the National Register under criterion D (36 CFR 60.4 (d)) because the site has yielded, and is considered likely to yield, information important in prehistory or history. Specifically, the site has potential to yield information on prehistoric resource procurement and use during the prehistoric occupation of the region.

Site 42SA24652 Ranching Camp

The most visible feature of Site 42SA24652 is a fence made of juniper and cottonwood branches, held together with notches and metal wire--both smooth and barbed. In the past, it extended from both sides of Salt Creek canyon across the canyon floor. Today, fence remnants are primarily on the east side of Salt Creek, extending from the east side of Salt Creek Road to the eastern canyon wall. A short section, including remnants of a gate, remains on the west side of the road. The gate is wire with branches used as vertical spacers that may represent a repair or different building episode. All components of the gate appear to be present. The only remaining fence sections on the west-northwest side of Salt Creek are located near the canyon wall. A piece of wire remains embedded in a cottonwood tree where the tree grew around it, and portions of logs are present in a shallow shelter on the bench that defines the western wall of the canyon. The west-northwest termination of the fence appears to have been accomplished by lodging posts into sockets that were dug in the shelter. It is probable that the fence, together with the canyon walls, served as a corral for keeping livestock to the south of this location. Cow dung is present among the rock shelters located on the east side of Salt Creek Road, south of the fence.

Also present at the site, on a bench overlooking the road, is a large rock shelter with potentially deep cultural fill. Ash and two historic metal cans (circa 1880 to 1940) were found on the shelter floor. The deep shelter fill and three prehistoric lithics found in adjoining rock shelters to the south (Isolated Occurrence Numbers 8, 9, and 10) suggest the possibility of a prehistoric component underneath the historic fill.

Below the rock shelter, adjacent to Salt Creek Road is a modern campsite with evidence of a campfire and past vehicle use. A large cottonwood log closes off vehicle access to the area, and it is currently re-vegetating.

The National Park Service believes this site is in fair physical condition and has the potential to yield archeological information. While cultural deposits appear to be relatively intact, the overall site is in fair condition based upon the fact that a portion of the fence is missing and the remaining sections have decayed. The segment of fence on the east-southeast side of Salt Creek Road is

fairly intact, with only one fallen fence post. Its structural integrity is probably due to the use of wire to support and bind the crossmembers. The short segment remaining on the other side of the road is less structurally sound. The fence segments on the west-northwest side of Salt Creek are largely collapsed and in poor condition. Footprints in the rock shelter indicate modern visitation, and the presence of cow dung points to use by cattle in the past. Soil deposits within the shelter are eroding along the slope that drops down to Salt Creek Road. Erosion of the shelter deposits is serious and is due in part to the steep drop from the shelter to Salt Creek Road. Vehicular traffic on the road appears to be accelerating the erosion process.

The site is eligible for nomination to the National Register under criterion D (36 CFR 60.4 (d)) because the site has yielded, and is considered likely to yield information important in prehistory or history. Further historical research (including field documentation and archival research), and archeological testing is necessary to determine if a prehistoric component is present.

Site 42SA24653 Lithic Scatter

Site 42SA24653 is a sparse, dispersed scatter of lithic flakes confined to the roadbed. The area surrounding the road was surveyed, and only one artifact was found (in an ephemeral drainage), suggesting that the site has been exposed by the road. The shoulders of the roadbed are sandy, making it impossible to view any stratigraphic layers that might reveal the location and depth of materials in the hillside.

The National Park Service believes this site is in fair physical condition and has the potential to yield archeological information. Artifacts appear only within the confines of the bed of Salt Creek Road. It is probable that they are being exposed as vehicle traffic deepens the roadway. Because the roadbed is sandy, the artifacts are experiencing only minor physical damage from pressure and grinding by vehicle traffic. However, the sandy banks or shoulders created by vehicular down-cutting will continue to collapse, exposing more of the site and causing ongoing damage to the site's archeological deposits. An adjoining social trail to a nearby campsite is not directly impacting the site because it rests on the sandy ground surface.

The site is eligible for nomination to the National Register under criterion D (36 CFR 60.4 (d)) because the site has yielded, and is considered likely to yield information important in prehistory or history. Archeological testing of the shoulders to determine the depth of the site, and the extent of cultural deposits is necessary for a thorough determination of significance.

Site 42SA24654 Lithic Scatter

The lithic scatter is confined to the bed of Salt Creek Road. The area surrounding the road was surveyed, but no other artifacts were found. This suggests artifacts are being exposed by vehicle traffic rather than washing into the road from the overlying bench. Because the site is 500 feet northeast of Peekaboo Arch Site (42SA1506 recorded in 1965), and is adjacent Salt Creek, a larger buried site may be present.

The National Park Service believes this site is in fair physical condition and has the potential to yield archeological information. Because artifacts appear only within the confines of Salt Creek Road, it is probable that they are being exposed as vehicle traffic deepens the roadbed. Since the majority of the roadbed is sandy, artifacts are experiencing only minor physical damage from pressure and grinding imposed by vehicle traffic. However, the sandy road shoulders created by vehicular down-cutting will continue to collapse, exposing more of the site and causing ongoing damage to the site's archeological deposits.

The site is eligible for nomination to the National Register under criterion D (36 CFR 60.4 (d)) because the site has yielded, and is considered likely to yield, information important in prehistory or history. Archeological testing of the shoulders to determine the depth of the site, and the extent of cultural deposits is necessary for a thorough determination of significance.

3.2.6 Riparian/Wetland Ecosystem

The National Park Service has adopted the definition of wetlands from Cowardin et al. (1979): lands transitional between terrestrial and aquatic ecosystems where the water table is usually at or near the surface or the land is covered by shallow water, as indicated by vegetation, soil, and/or hydrologic characteristics. Riparian areas are contiguous to and affected by surface and subsurface water of perennial or intermittent water bodies (lakes, streams, drainage ways, etc.), and are considered transitional between wetland and upland (USFWS 1997, Prichard et al. 1995). Platts and Jensen (1986) describe riparian ecosystems in the interior West as inclusive of vegetated wetlands in addition to somewhat drier habitats that are not in conformance with the Cowardin et al. (1979) criteria. These mesic riparian ecosystems are both spatially and functionally integrated with wetlands in complex fashions. They suggest that the concept of riparian/wetland ecosystems may be more applicable to the arid regimes of the western region. This concept is implied with the term "riparian" throughout the remainder of this discussion.

Riparian/wetland areas occupy a small portion of the land area in the arid west (less than one percent), but their ecological importance is disproportionate to their limited extent. For example, 50 to 80 percent of bird species are dependent on riparian habitats (Ohmart and Anderson 1982, Knopf et al 1988). Riparian/wetland areas are also among the habitat types most altered by humans. An estimated 53 percent of wetlands have been lost in the lower 48 states since the 1780s (Dahl 1990); in Utah, riparian habitat loss is estimated at 95 percent or more (Krueper 1992).

The Salt Creek four-wheel-drive road predates the Federal Water Pollution Control Act (Clean Water Act) of 1972, as amended, under which discharge of dredged or fill material into waters of the U.S., including wetlands, is regulated. Thus it is considered an existing structure which may be maintained under U.S. Army Corps of Engineers Nationwide Permit 3 (33 CFR Part 330), provided that environmental effects from repair are minimal. It also predates the 1980 NPS Wetland Protection Guidelines, thus maintenance of the road (but not full reconstruction or expansion) is allowed as an "excepted action" under the current NPS Director's Order 77-1, Wetland Protection, which implements Executive Order 11990, Protection of Wetlands, and a wetland statement of findings is not necessary. Nevertheless, Directors Order 77-1 directs that decisions to retain such facilities be supported by a discussion of why relocation to non-wetland sites is not practicable.

Current and contemplated uses and management of Salt Creek (four-wheel-drive road, foot trails, isolated/undeveloped backcountry sites, camping) are also excepted actions under the NPS Floodplain Management Guideline, so a formal delineation of regulatory floodplains has not been completed for the entire Salt Creek canyon and a floodplain statement of findings will not be prepared. A reconnaissance survey and floodplain modelling for several then-existing campsites in Salt Creek (Peekaboo, Angel Arch, Bates Wilson) was conducted during the backcountry

management planning process (Martin 1993). Sites below the alluvial sagebrush/cottonwood terrace were found to be in the 100-year floodplain and were subsequently closed. Campsites currently at Peekaboo are out of the regulatory floodplains. In general, any location below the elevation of the alluvial terrace can be considered to be subject to some flood hazard, with the level of hazard diminishing with height above the stream channel.

3.2.6.1 Geomorphology

Salt Creek has incised an arroyo through alluvium in the canyon bottom, with the creek channel as much as 30 feet below the tops of the adjacent terraces. A period of arroyo-cutting occurred throughout the southwestern U.S. and Colorado Plateau between approximately 1880 and 1940 (Webb et al. 1991, Leopold 1994, Hindley et al. 2000, Vogt 2001, Hereford 2001, Webb 2001). This region-wide erosion has been extensively studied elsewhere and various causes have been proposed, generally involving climate changes and/or human land uses including grazing, agriculture, timber cutting and road construction (DeBano and Schmidt 1989, Leopold 1994, Vogt 2001, Webb 2001; Webb et al. 1991 includes a lengthy list of past studies and suggested causes). Webb (2001) assigns a similar time frame to Salt Creek, estimating that downcutting may have ended there as late as 1941. The stream channel has eroded to bedrock in several locations. Comparison of aerial photographs of Salt Creek from the 1950s and 1995 (USGS 1952 and 1953; USBLM 1995) indicates that the stream channel was considerably wider and less densely vegetated in the 1950s than at present. This is consistent with other streams throughout the semi-arid western U.S. (Leopold 1994).

Agenbroad and Mead (1992) note that the canyon section from the Upper Jump to the Horse Canyon junction is much narrower, with a steeper gradient (102 feet per mile vs. 68 feet per mile), than the upper reach (above the Upper Jump) and lower reach (below the Horse Canyon junction). They observe that runoff and streamflow have been concentrated within a much narrower floodplain and have had more erosive impact in the middle reach (Upper Jump to Horse Canyon). The lower reach is characterized as a depositional environment for sediments eroded from the upper and middle reaches.

Salt Creek includes sections of C and E stream types according to the Rosgen (1996) stream classification system (Elmore et al. 2001). C stream types are low gradient (less than 2 percent), meandering, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains. E stream types are low gradient (less than 2 percent), meandering riffle/pool streams with low width/depth ratio and little deposition. The major difference between C and E types is that E type natural channels have a very low width/depth ratio and no point bars. The creek includes sections of C1 (bedrock-dominated streambed), C3 (cobble-dominated bed), C4 (gravel-dominated bed) and C5 (sand-dominated bed) stream types (Elmore et al. 2001, Schelz 2001) .

The National Riparian Service team (Elmore et al. 2001) defined three reaches of Salt Creek between the Upper and Lower Jumps:

- Lower Jump to the Horse Canyon junction. The Salt Creek four-wheel-drive road runs along the upper two miles of this reach, running directly in the channel for about 75 percent of the channel length from the Cave Spring area to Horse Canyon. (The lower part of the section is also parallelled by the Colorado River Overlook four-wheel-drive road.) This reach was classified as a C5 stream type (sand-dominated). At a randomly-selected point where the jeep road is in the streambed, channel width/depth ratio was 17.6 in 1999 (Schelz 2001).

- Horse Canyon to Angel Arch side canyon. The four-wheel-drive road runs along and in the channel of this section; vehicles currently may travel the lower mile (as far as Peekaboo), but have not been permitted above Peekaboo since summer 1998. Approximately 19 percent of the channel length of this section is occupied by the road. Most of this reach is either a C4 or a C5 stream type, with the remainder an E5 type. C4 channels are similar to C5 channels but dominated by gravel rather than sand. Channel width/depth ratio at several cross-sections where the four-wheel-drive road runs in the channel ranges from 10.8 to 44.9, with an average ratio of 25.9. Width/depth ratios at cross-sections where the jeep road is out of the channel range from 4.2 to 10.9, with an average ratio of 7.0 in 2000 (Schelz 2001).

- Angel Arch side canyon to Upper Jump. Vehicle travel ceased on the lower half-mile of this reach in 1995, and on the remainder in the 1970s. This reach is a combination of C4 and E5 channel types. Channel width/depth ratios at two cross-sections monitored by NPS range from 4.7 to 10.0, with an average of 7.4 in 2000 (Schelz 2001).

Width/depth ratio and stability, and thus functionality, of the stream types found in Salt Creek are highly influenced by the extent and character of riparian/wetland vegetation (Elmore et al. 2001, Prichard et al. 1998). Both C4 and C5 channel types are very susceptible to shifts in both lateral and vertical stability caused by direct channel disturbance and changes in the flow and sediment regimes of the contributing watershed (Rosgen 1998). The holding power provided by roots and above-ground biomass of riparian vegetation allows sand deposits to be stabilized, building streambanks and floodplains.

Since the pre-1940 downcut, a functional floodplain has begun to reestablish along parts of the Salt Creek channel at the lower base level. However, geomorphic characteristics affecting the landform's ability to dissipate flood energy have not yet reached a fully functioning condition in the two reaches from the Lower Jump to the Angel Arch tumoff (Elmore et al. 2001). A floodplain is considered active or functional if the one to three year flood can overtop the streambank and reach the adjacent floodplain (Prichard et al. 1998, Gebhart et al. 1989). This hydraulic connection between the channel at bankfull stage and the floodplain serves several important functions. Flows in excess of channel capacity spread over the floodplain, where vegetation and other debris provide a substantial resistance to flow, dissipating stream velocity and erosive force (Prichard et al. 1998, Prichard et al. 1995, DeBano and Schmidt 1989, Li and Shen 1973, Petryk and Bosmajian 1975) and filtering sediment (Logan and Clinch 1991, Welsch 1991, Lowrance et al 1984). Reduction of water velocity allows sediment to settle and water to percolate into the soil mantle, watering plants and providing subsurface storage (Platts and Nelson 1989, DeBano and Schmidt 1989, Gebhardt et al. 1989, Elmore and Beschta 1987, Brinson et al. 1981). Water stored in these aquifers sustains late-season streamflow (Connin 1991, Chaney et al. 1990, DeBano and Hansen 1989). Development of riparian/floodplain vegetation stabilizes soils against erosion (e.g. Elmore et al. 2001, Prichard et al 1998, Clifton 1989, DeBano and Schmidt 1989). When the floodplain is inactive, this can have a significant effect on the soil-water regime and vegetation (Gebhart et al. 1989). If the one to three year flood cannot reach the floodplain, runoff is concentrated in the channel, resulting in higher velocity flows which can accelerate erosion, incise the channel, and carry more sediment.

A headcut, indicating potential vertical channel instability, has developed in a Salt Creek overflow channel near the Angel Arch side canyon. Consequently, the channel is susceptible to downcutting from this point upstream to the next geological or structural control, such as bedrock outcrops. Should the headcut progress upstream, further eroding the channel and banks, a considerable amount of riparian vegetation and fine alluvial sediment could be lost, also reducing water retention capability.

3.2.6.2 Hydrology

Groundwater and Persistence of Surface Water

Surface water is limited in areal extent and duration in Canyonlands. Other than the Green and Colorado Rivers, most canyons in the park have surface water only from infrequent, discontinuous springs, seeps or potholes, and flowing water only after rainstorms or snowmelt. Salt Creek, in contrast, has higher-flow springs, more and larger year-round pools, and longer periods of flowing surface water.

Salt Creek is considered an intermittent or interrupted stream (Elmore et al. 2001; Prichard 2002). An intermittent stream flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow; an interrupted stream has discontinuities in space (Elmore et al. 2001). Sections of the Salt Creek have year-round surface water, supported by several springs and seeps. In other sections the water table drops below the surface for parts of the year. This interrupted surface flow may be associated with a year-round base flow with a large part of the water moving as shallow alluvial groundwater (Inglis 2001). The creek has continuous surface flow during periods of snowmelt and storm runoff. Characteristics of perennial surface water in three sections of Salt Creek with differing motor vehicle status (current vehicle traffic, vehicle traffic until summer 1998, and no vehicle traffic in recent decades, if ever) are as follows:

- Below Peekaboo: Locations of perennial surface water include the Peekaboo Spring and pools it supplies in the vicinity of the Salt Creek/Horse Canyon junction. Some distance downstream from the Horse/Salt junction, surface flow generally ceases for parts of the year (e.g. mid-summer periods without rain).

- Peekaboo to Angel Arch turnoff: Several pools, seeps or stream sections have perennial water in this reach, including nine pools or seeps monitored by the park.

- Angel Arch turnoff to south park boundary: Locations of perennial surface water include springs and sections downstream from the junction of the East and Main Forks and the Upper Jump. The park currently monitors two perennial pools approximately one mile and 0.25 mile, respectively, upstream from the Angel Arch turnoff, and in the 1980s and early 1990s monitored the perennial spring at the Upper Jump.

Average annual flow for Salt Creek is estimated at less than five cubic feet per second (cfs). The annual flood, or a flow with a recurrence interval of 1.5 to 3 years, is estimated at 300 to 700 cfs using methods from Hedman and Osterkamp (1982) and comparison of similar gaged watersheds (USGS 1986).

The Salt Creek alluvial aquifer is the source of domestic water for the Needles district, from a well near Cave Spring. The water bearing zone for the well is about 30 feet of saturated alluvium perched on top of the Cedar Mesa Sandstone formation (Martin 2001).

The variation in duration of surface flow may be related to various conditions along the stream, such as presence of an active floodplain, extent of alluvial material, soil mantle and vegetation characteristics, and human uses, all of which are in turn affected by hydrologic factors. The availability of bank and floodplain storage in sediment deposits adjacent to streams may increase riparian vegetation and extend the period of surface flow (Gebhardt et al. 1989). Lysimeter

studies have shown that saturated soils drain slowly by unsaturated flow and can sustain outflow for as long as three to four months after being charged with water (DeBano and Hansen 1989). Numerous examples exist in the semi-arid western U.S. where streamflow originating from intact riparian zones is perennial, but a degraded section of the same stream is ephemeral (Green and Kaufmann 1989, Elmore and Beschta 1987), or where the duration of streamflow increased after changes in land management (e.g. grazing systems, revegetation, etc.) (Connin 1991, Chaney et al. 1990, DeBano and Hanson 1989).

The Salt Creek water table likely dropped when the pre-1940s downcut occurred. Terrace downcutting has removed a large volume of alluvium, eliminating a large portion of the shallow alluvial aquifer (Springer 2001). This likely led to a significant reduction in the storage of water that is possible in this smaller aquifer. The location, magnitude and duration of perennial surface flow in Salt Creek have likely changed as a result of this change in channel morphology.

Comparison of 1950s aerial photos, by Elmore et al. (2001) and park staff, indicates that vegetation has increased along Salt Creek since then, improving streambank stability, and the channel has narrowed. There has likely been some stabilization of the channel by vegetation and possible improvement of water storage since the downcut.

Flood Characteristics

Salt Creek is subject to flash floods because of storm characteristics and the limited infiltration capacity of the watershed (extensive bare rock or shallow, coarse textured soils).

Floods of various recurrence intervals were estimated from Salt Creek stream channel cross-sections, using methods from Hedman & Osterkamp (1982):

Flood recurrence interval	Flow (cfs) + std. error of estimate (%)
2-year recurrence	584 ± 120%
5-year recurrence	1616 ± 73%
10-year recurrence	2300 ± 60%
25-year recurrence	3615 ± 62%

Since 1992, Salt Creek has had three floods large enough to cause damage necessitating road repair by mechanical equipment, in 1992, 1995, and 2001 (Nester 2001). With the most recent flood, in August 2001, 1.5 inches of rain were recorded by USGS scientists along Salt Creek near Peekaboo (Graham 2001), while the Needles weather station (about four miles away) recorded 1 inch. Based on National Weather Service estimates of rainfall recurrence intervals (NOAA 1973), 1.5 inches corresponds to approximately a five-year storm. While actual Needles weather station precipitation records since 1965 suggests that 1.5-inch rainstorms are less frequent than an average five-year recurrence (1.56 inches is the highest recorded one-day rainfall since 1965), the recurrence interval of floods in Salt Creek causing enough erosion to require road repair by mechanical equipment appears to be about 5 years.

Water Quality

Chemical/Physical Characteristics, State Water Quality Standards

Riparian areas can improve the quality of water leaving the watershed (DeBano and Schmidt 1989). Reduction of water velocity by vegetation and floodplains promotes trapping of sediments that could otherwise degrade water quality (Cooper et al. 1987). Intact riparian zones have been

found to function as important sites for denitrification (Coats et al. 1976, Lowrance et al. 1984, Jacobs and Gilliam 1985) and to absorb significant quantities of phosphorus (Brinson 1977, McCallister and Logan 1978, Yarbro 1979). Phosphorus in runoff from surrounding uplands is removed by deposition (Cooper and Gilliam 1987) and immobilized by vegetation uptake (Yarbro 1979). Overhanging riparian vegetation moderates the thermal regime of aquatic communities by providing cooler instream temperatures (Meehan et al. 1977, Swanson et al. 1982). Lack of riparian vegetation can result in higher water temperatures and decreases in dissolved oxygen (Brown 1983). Less dissolved oxygen reduces populations of consumer and decomposer organisms, increasing the amount of nutrients exported from the watershed (Green and Kauffman 1989).

Utah water quality standards designate Salt Creek for the following beneficial uses:

- Class 1C. Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water
- Class 2B. Protected for secondary contact recreation such as boating, wading, or similar uses.
- Class 3B. Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
- Class 4. Protected for agricultural uses including irrigation of crops and stock watering.

The park has monitored three sites in Salt Creek for water quality since 1995. Sites were sampled two to four times per year until 2001, then twelve times per year since 2001, for physical and chemical characteristics:

- Peekaboo Spring, in the section still travelled by vehicles,
- a pool near Crescent Arch, in the section where vehicle travel ceased in 1998, and
- a pool at the former Bates Wilson campsite, where vehicle travel ceased in the 1970s.

To minimize the influence of temporary increases in sediment load after flash floods, no samples are taken until at least two days after rainstorms.

Salt Creek has few potential pollution sources within the park. Those that exist are primarily recreation-associated sources such as human waste, vehicles, recreation-related erosion and sedimentation, and substances used by recreationists such as soap, sunscreen and insect repellent which may wind up in the creek. There are no point source pollution discharges into the creek. Most water quality standards have been met in most Salt Creek samples, and the creek is not on the state list of impaired water bodies pursuant to section 303(d) of the Clean Water Act (Utah DEQ 2000).

Occasional exceedences of a few water-quality standards and pollution indicators have occurred at Salt Creek monitoring sites since 1995. Parameters which have had exceedences include total suspended solids (TSS), turbidity, temperature, phosphorus, dissolved oxygen, and chromium. Water quality sampling data can be found in appendix 1.

Benthic Macroinvertebrates

Aquatic species diversity is an indicator of the biotic health of a stream (Dunne and Leopold 1978). Populations of aquatic organisms can be affected by types of pollution that dissipate before they can be detected by infrequent physical/chemical tests, such as short-lived chemical spills, or that are not discerned by the particular chemical/physical tests used. Populations can also be influenced by various other factors, including variations in temperature, precipitation, water levels, sediment, etc. High diversity is indicated by many forms or species, but not a

predominance of any one form.

The park began regularly monitoring aquatic macroinvertebrates in 1997, when vehicles were still travelling the Peekaboo to Angel Arch section. Twelve Salt Creek pools are sampled at least twice per year, within the three canyon sections of varying vehicle use (currently traveled by vehicles, vehicle travel ceased in 1998, vehicle travel ceased in the 1970s). Monitoring data suggest that species richness, or the number of species present, is higher in the pools above Angel Arch junction than in the pools below Peekaboo (Schelz 2001). Macroinvertebrate monitoring results are shown in appendix 1.

Wolz and Shiozawa (1995) sampled benthic macroinvertebrates in Salt Creek and three other Needles district canyons (Squaw, Lost, Big Spring) in spring 1994. The number of species found at the pool just downstream from the Angel Arch turnoff was the highest of all sites in the four canyons sampled (appendix 1).

3.2.6.3 Vegetation

Riparian vegetation along Salt Creek includes species of cottonwood, willow, rush, sedge, cattail, and tamarisk (see appendix 3). The U.S Fish and Wildlife Service (Reed 1998) classifies most of these species as "obligate wetland" or "facultative wetland" plants in Utah; these categories are the most likely to be found in wetlands and thus generally indicate the extent of the riparian/wetland area. (Obligate wetland plants have an estimated probability over 99 percent of occuring in wetlands, facultative wetland plants have an estimated probability of 67 to 99 percent.) Mature cottonwoods are also growing on alluvial terraces well above the current Salt Creek stream level. These cottonwoods established when the stream flowed at the level of the terraces, before the most recent downcutting episode, and are supported by roots that reach the current water table.

Riparian vegetation species on Salt Creek are indicators of an early seral (successional) community type, dominated by species that establish on disturbed soils. Later seral sedge and rush species are present but not dominant. The potential plant community (if succession continues) would be more diverse, and contain a mix of more sedge and rush species (Elmore et al. 2001).

Vegetation is influenced by geomorphic and hydrologic factors, and in turn influences these factors. An accessible floodplain that is overtopped regularly by floods sustains vegetation, which reduces water velocity and allows sediment deposition and water retention, which further promotes vegetation. The relationship between vegetative cover and runoff and erosion throughout the western U.S. has been extensively documented by numerous investigations over several decades (DeBano and Schmidt 1989 has a lengthy list of past research). Vegetation is the most important factor influencing soil and stream channel stability (DeBano and Schmidt 1989). Vegetative cover stabilizes stream banks and holds soil in place, providing protection from erosive forces and dissipating stream energy during high flows (Elmore et al. 2001, Prichard et al. 1998, Prichard et al. 1995).

Total Area of riparian vegetation along Salt Creek was estimated from aerial photographs (USGS 1995):

- Overall (south park boundary to Cave Spring, 24 canyon/linear miles): 347 acres; average 15 acres per mile

- Cave Spring to Peekaboo (3.5 canyon/linear miles): 134 acres; 38 acres per mile
- Peekaboo to Angel Arch turnoff (8.3 canyon/linear miles): 56 acres; 6.7 acres per mile
- Angel Arch turnoff to south park boundary (11 canyon/linear miles): 157 acres; 14 acres per mile

For comparison, riparian vegetation area in two other park canyons was also estimated:
- Lost Canyon (7 canyon/linear miles): 28 acres; 4 acres per mile
- Horse Canyon (7 canyon/linear miles): 19 acres; 3 acres per mile

While the most extensive riparian vegetation in Salt Creek is below Peekaboo, this area is dominated by tamarisk, an invasive exotic species which often forms monocultural stands. Tamarisk is generally a lower value species than riparian natives such as willows, cottonwoods, rushes, and sedges, for physical as well as biotic characteristics. Tamarisk in sandy soils is rated six on a one to ten scale for bank stability (compared to nine or ten for native riparian species; Winward 2000). Tamarisk generally has lower wildlife value compared to native riparian vegetation, although some bird species will nest in tamarisk (Carpenter 1998, Hunter et al. 1998, Ellis 1995, Kasprzyk and Bryant 1989, Engel-Wilson and Ohrnart 1978, Anderson et al. 1977, Shrader 1977). Because this species can totally dominate a site and keep other species from establishing, it impedes vegetative biodiversity (Elmore et al. 2001, Lovich et al. 1994, Frasier and Johnson 1991, Crins 1989, Weeks et al. 1987). Tamarisk can also reduce macroinvertebrate species richness and abundance (Bailey et al. 2001, Neill 1985, Egan et al. 1993), increase the severity of floods and fires (Di Tomaso 1998), lower water tables and dry out habitat (Di Tomaso 1998, Brotherson et al. 1984), and concentrate salts on the soil surface (Shafroth et al. 1995). Tamarisk becomes less extensive above Peekaboo, possibly related to the narrower, steeper canyon or different soil characteristics. This is consistent with a change in the canyon-bottom soil type near Peekaboo, noted in the soil survey (USSCS 1991).

Other relatively long continuous (though sometimes narrow) expanses of riparian vegetation are located from the Upper Jump to the vicinity of the Angel Arch turnoff and around the confluence of the East and Main Forks of upper Salt Creek.

Vegetation varies in its soil stabilizing capability. Native riparian species such as sedges, rushes, cattails and associated communities form a dense mat, with root masses capable of withstanding high flows (Prichard et al. 1998, Winward 2000). These species and associated communities are rated nine or ten on a one to ten scale for stability (Winward 2000; a ten rating is the most stable). (In contrast, tamarisk is rated six for stability; Winward 2000).

The park established a monitoring program for riparian conditions, including vegetation, on Salt Creek in 1998 (Schelz 2001). Thirteen cross-valley transects are monitored, located between Cave Spring and the Upper Jump in canyon sections with and without vehicle travel. Monitoring data can be found in appendix 2.

As part of a functioning condition assessment of Salt Creek, the interagency National Riparian Service Team team estimated the average percentages of streambanks covered by native riparian vegetation by reach, excluding rock outcrop areas (Elmore et al. 2001):
- Lower Jump to Horse Canyon junction: Less than 60 percent cover.
- Horse Canyon junction to Angel Arch turnoff: 60-70 percent cover.
- Angel Arch turnoff to Upper Jump: Over 90 percent cover.

Stream types in all three reaches (C5 and E5, sand-dominated; and C4, gravel-dominated)

require at least 85 percent bank cover, by plant communities with root masses capable of withstanding high streamflow events (sedges, rushes, bulrushes, cattails, etc.), in order to be in properly functioning condition (Elmore et al. 2001, Winward 2000).

3.2.6.4 Riparian-Wetland Functioning Condition

DeBano and Schmidt (1989) define riparian health as:

> the stage of vegetative, geomorphic, and hydrologic development, along with the degree of structural integrity, exhibited by a riparian ecosystem. As such, riparian health reflects an equilibrium condition between aggradation and degradation processes operating within the riparian area, which is dependent upon the condition of the surrounding watershed... [and] a dynamic interrelationship between runoff and erosive forces, where precipitation forces producing runoff are counteracted by vegetative, geomorphic, and structural resistance... When this natural system is in equilibrium, it maintains a level of stability tending to dissipate potential energies that would otherwise cause rapid changes...[S]hort-term increase in flow causes an oscillation in the balance between erosion and deposition. [However], it is quickly dampened by the channel characteristics. As a result, there is no permanent change in the central tendency toward maintaining an equilibrium between aggradation and degradation processes in the riparian area.

Prichard et al. (1998) equate riparian health and functioning condition, and further explain:

> In a healthy condition, the channel network adjusts in form and slope to handle increases in stormflow/snowmelt runoff with minimal disturbance of channel and associated riparian-wetland plant communities.

The Bureau of Land Management has developed a process for assessing the functioning condition of riparian areas. According to this Properly Functioning Condition approach (Prichard et al. 1998, 1995), a riparian-wetland area is in properly functioning condition (PFC) when adequate vegetation, landform, or large woody debris are present to:

- dissipate stream energy associated with high waterflow, thereby reducing erosion and improving water quality;
- filter sediment, capture bedload, and aid floodplain development;
- improve flood-water retention and ground-water recharge;
- develop root masses that stabilize streambanks against cutting action;
- develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses;
- support greater biodiversity.

Two other possible classifications are possible under this system:

- Functional—at risk. Riparian-wetland areas that are in functional condition, but existing soil, water or vegetation attributes make them susceptible to degradation. Trend (change over time) is also assessed for areas in this category, and classified as upward (improving), downward (deteriorating), or not apparent (static).
- Nonfunctional. Riparian-wetland areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows, and thus are not reducing erosion, improving water quality, etc.

The interagency National Riparian Service Team assessed Salt Creek (Elmore et al. 2001) using the PFC methodology. The team divided the creek into five reaches with similar characteristics, then focused their assessment on the two reaches affected by the Salt Creek four-wheel-drive road and one additional reach for comparison. The team's evaluations of these three reaches follows:

- Lower Jump to Horse Canyon junction: *Functional—at risk with no apparent trend (recent years).* This reach was considered inadequate in sinuosity, channel/floodplain connectivity, and streambank vegetative cover, all of which are needed to dissipate flood energy and provide protection from erosive forces, but adequate in other attributes. While analysis of aerial photos between 1953 to 2001 indicated substantial improvement in functioning condition, the team found no evidence of additional progress in recent years.

- Horse Canyon junction to Angel Arch turnoff: *Functional-at-risk with an upward trend.* This reach lacked adequate vegetative cover for bank protection and energy dissipation during high flows, but was adequate in other attributes. This reached also showed considerable improvement since the 1953 aerial photos. Continuation of this upward trend in recent years was indicated by recruitment of willows, cottonwoods, and herbaceous bank-stabilizing species, narrowing of the stream channel and widening of the riparian zone in places, reestablishment of riparian vegetation species, sediment filtering, and new bank building occurring in old road crossings.

- Angel Arch tributary upstream to the Upper Jump: *Properly functioning condition.* All attributes on the PFC checklist were found to be in a working order or not applicable. The riparian area has recovered since the 1950s and will accommodate relatively frequent high flows such as 5-, 10-, and 20-year floods.

The team also conducted an ocular assessment of the condition of Salt Creek in 1953, using 1953 aerial photographs, and classified all three reaches as nonfunctional at that time. The team speculated that the 1953 condition resulted from livestock grazing, and that the improvement since then resulted from the cessation of grazing in the 1970s.

The PFC assessment can be found in in Appendix 3.

3.2.7 Economic Environment

The economic factors most likely to vary with Salt Creek management alternatives are those influenced by park visitation. Park visitors obtain lodging, food, gasoline, and other supplies from area businesses. Some visitors also purchase services, such as guided vehicle, river, backpack, and mountain bicycle trips. Economic effects of these activities can be represented by measures of visitation or revenue.

For purposes of this assessment, the four counties in which the park lies, San Juan, Grand, Wayne and Garfield Counties, are assumed to capture the bulk of Canyonlands-related visitor spending. Spending associated with Needles district and Salt Creek visitation is assumed to affect primarily the two counties through which this part of the park is accessed, San Juan and Grand Counties. Tourism is an important contributor to the economy of the Canyonlands region.

Total personal income for the four counties occupied by the park was estimated at over $389 million for 1996 (Utah Governor's Office of Planning and Budget 2002). Total personal income for San Juan and Grand Counties, the two counties primarily affected by visitation to the Needles district and Salt Creek, was estimated at $280.3 million for 1996 .

3.2.7.1 Economic Effects of General Park Visitation (Noncommercial and Commercial)

Total economic effects from park visitation are not comprehensively counted. However, this section assumes that measures of visitation can be used as indicators of economic effects. Estimates for average spending from non-local visitors range from $25 to over $100 per recreation visitor-day (Caughlin 1998, Utah Office of Planning and Budget et al. 1992, Homback 1990, Littlejohn 1990).

Data in this section covers overall Canyonlands visitation: park visitors who use commercial guiding/outfitting services as well as those who do not. Information on economic effects specific to commercial services is presented in section 3.2.7.2.

The NPS uses the following definitions:

- A *visit* is the entry of one person, except NPS personnel, onto lands or waters administered by the NPS. Same-day reentries, negligible transits, and entries to detached portions of the same park are considered as a single visit.
- A *recreation visitor-day (RVD)* is the presence of one or more persons, excluding NPS personnel, in a park for continuous, intermittent, or simultaneous periods of time aggregating twelve hours (e.g., one person for twelve hours, two persons for six hours each, etc.).

Parkwide use

Total parkwide visitation was stable from 1993 to 1999 (Figure 3), ranging between about 430,000 and 450,000 annual visits, and fluctuating less than 2 percent annually on average during this period (NPS 1993-2000, 2001). The two years prior to this period had increases of 10 percent or more. The two subsequent years (2000 and 2001) had similar declines, consistent with a regional decline in park visitation, reaching about 368,000 visits in 2001. Recreation visitor-days ranged between 360,000 and 382,000 from 1992 to 2000, fluctuating an average of 2.5 percent per year during this period. Both visits and RVDs increased slightly parkwide in 1998, the year vehicle travel ceased from Peekaboo to Angel Arch, and in the following year.

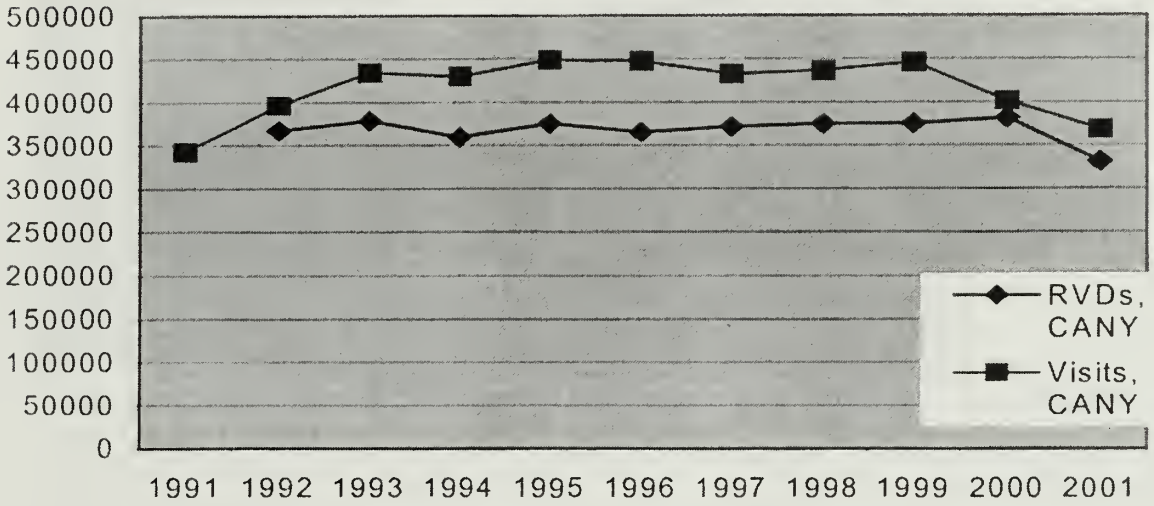
The NPS Money Generation Model (Homback 1990) estimates non-local visitation at 90 percent, and total direct visitor spending at over $36 million, from Canyonlands National Park visitors, based on total 1996 recreation-visitor-days. Parkwide RVDs have increased slightly each subsequent year through 2000, which would cause a slight increase in this visitor spending figure.

Salt Creek-specific use

On average, approximately 1 percent of the total number of visitors to Canyonlands visit the Peekaboo to Angel Arch section of Salt Creek, generating approximately 1.5 percent of the total park RVDs; many Salt Creek visitors visit other park destinations as well. Using the Money Generation Model estimate above, this would generate approximately $540,000 in direct visitor spending.

Salt Creek receives use by vehicle drivers as well as hikers/backpackers, single-day use as well as camping. All these uses, and related spending, may fluctuate as a result of various factors, including those unrelated to whether or not vehicle access is permitted (national and international economies, weather, tourism trends etc).

Figure 3. Total CANY Visits & Recreation Visitor-Days



The Salt Creek system includes Horse Canyon and numerous other tributary canyons. Vehicles are currently permitted to drive up Salt Creek from Cave Spring to Peekaboo, and/or up Horse Canyon (reached via Salt Creek), and before July 1998 were permitted to continue to within a half-mile of Angel Arch. Salt Creek from about Cave Spring to about the Angel Arch turnoff, Horse Canyon, and other side canyons are included in one backcountry zone (Salt Creek/Horse Canyon zone); the upper section of Salt Creek is a separate backcountry zone (Upper Salt Creek zone). In the following discussion "Salt Creek use" includes Salt Creek, from Cave Spring to Angel Arch, Horse Canyon, and other tributary canyons, but not the Upper Salt Creek zone, unless noted otherwise.

Vehicle day use: Annual total numbers of day-use vehicles in Salt Creek (including Horse Canyon), fluctuated widely (over 50 percent) up and down in the years before the vehicle prohibition above Peekaboo (1996 and 1997), with annual fluctuations decreasing in subsequent years (Figure 4). Annual visitor spending related to this activity is assumed to have fluctuated similarly. Use rose 26 percent in 1998, the year vehicles ceased above Peekaboo, dropped 28 percent in 1999, then increased less than 10 percent in each of 2000 and 2001, rising back above the 1997 level. (2001 growth contrasts with general sharp declines in visitation that year, possibly related to the events of September 11.)

Backpacking and vehicle camping use: NPS has limited data on use before the vehicle injunction; Salt Creek-specific noncommercial RVD records go only as far back as 1998, but this does include part of the primary use period during one year (spring through late June 1998) when vehicles were still permitted above Peekaboo. Backpacking RVDs in the Salt/Horse zone increased 17 percent in 1999 and 73 percent in 2000, then dropped four percent in 2001 (Figure 5). Vehicle camping RVDs at the Peekaboo camp declined 15 percent in 1999, then gained 46

percent in 2000 and nine percent in 2001. Related visitor spending is assumed to have parallelled these changes in use.

Figure 4. Annual Totals, Vehicle Day Use Permits, Salt Creek

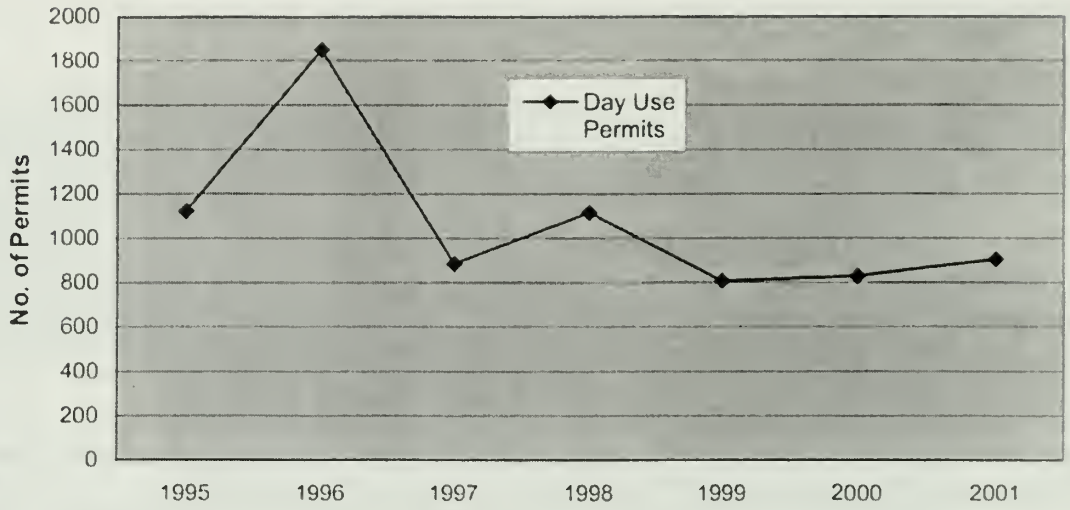
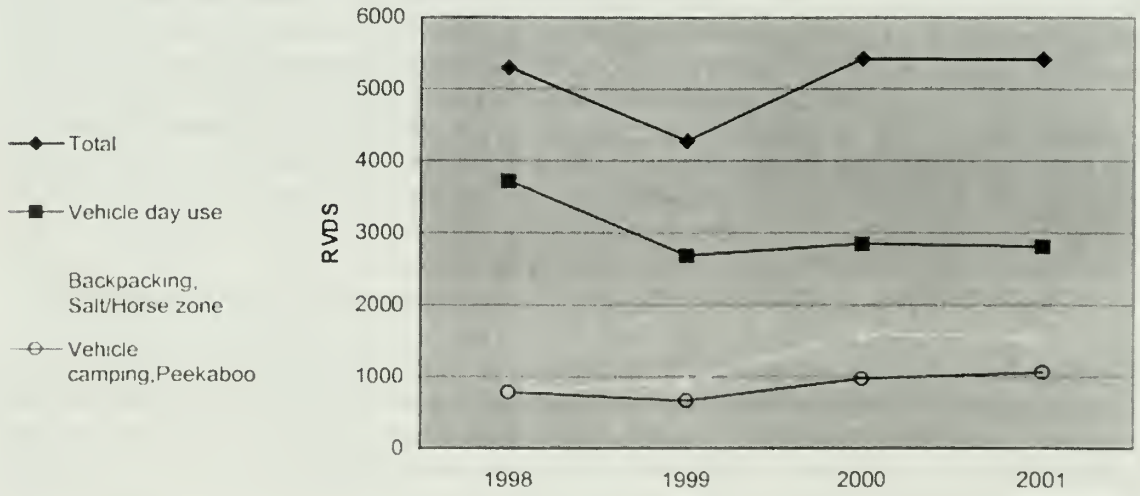


Figure 5. Salt Creek Total Use, Recreation Visitor-Days



Combined use, all types: Total recreation visitor-days (vehicle day use, vehicle camping, day hiking, and overnight backpacking) in this section of Salt Creek dropped about 19 percent from 1998 to 1999 (Figure 5), driven by decreases in vehicle day trips and camping (backpacking increased in this period). In subsequent years, increases in backpacking and vehicle camping, as well as a smaller increase in vehicle day use, combined to raise total Salt Creek use to over 5400 RVDs, about 2 percent above the 1998 level. Related spending for visitation to Salt Creek is assumed to have parallelled these changes.

3.2.7.2 Commercial Services

About twenty businesses offer a variety of services in Canyonlands, including four-wheel-drive-vehicle trips, river trips, mountain bike trips, backpacking trips, and photography trips. Three of the concessioners conduct vehicle tours; each of these three also provide other types of trips, such as river trips. Prior to July 1998, the Angel Arch trip, via Salt Creek, was one of several guided four-wheel drive tours offered. A number of other four-wheel-drive roads continue to be available for vehicle outings, as does Salt Creek to Peekaboo and/or to Horse Canyon.

Economic effects of commercial use can be represented by gross receipts or by recreation visitor-days (RVDs). Both types of data are presented in this section. Commercial RVD data can be subdivided into park districts or in some cases more specific locations, such as backcountry zones. Commercial gross receipts can generally be assigned to individual activities, such as backpacking or vehicle tours, but are recorded on a park-wide basis, not by individual destinations. Thus variations in income specifically related to use of the Needles district or Salt Creek are not possible to identify, but they can be correlated to commercial RVDs for the Needles district or Salt Creek.

Recreation visitor-days (RVDs)

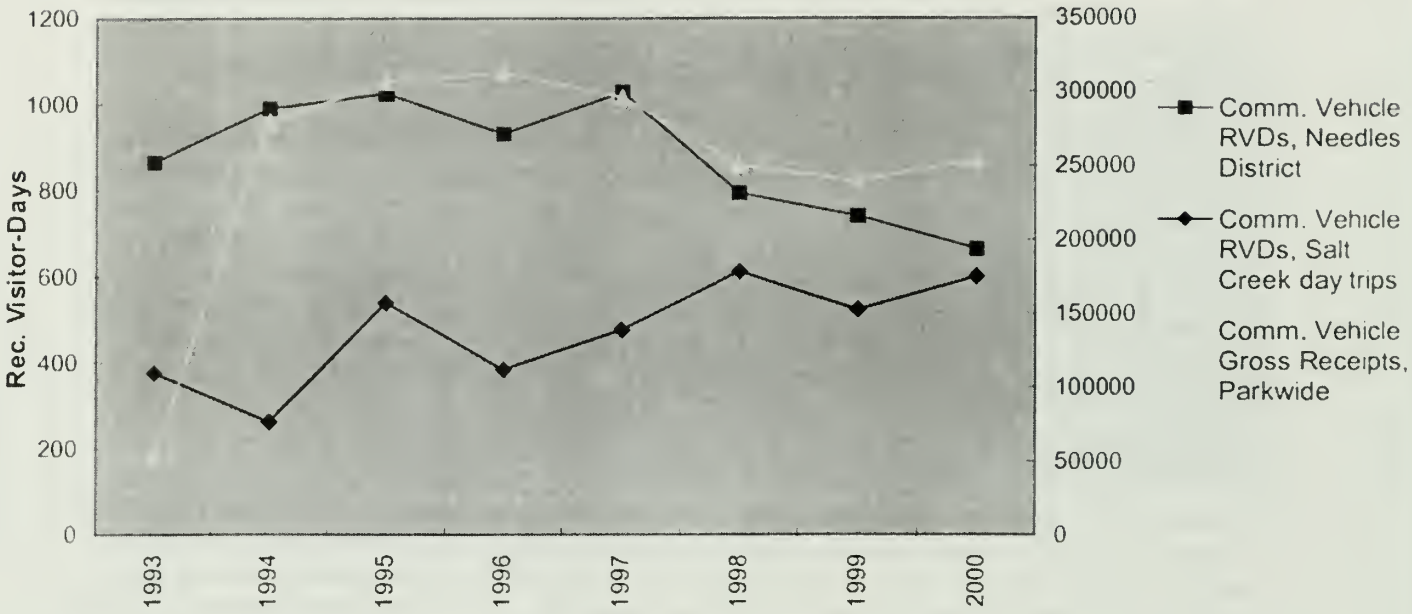
Commercial RVDs from vehicle trips only, Salt Creek and Needles-wide: Salt Creek (including Horse Canyon) vehicle day use (the bulk of Salt Creek concession vehicle use) fluctuated an average of 47 percent per year up or down from 1993 to 1997, and 19 percent per year from 1998 to 2000, ranging from 261 to 612 RVDs annually (Figure 6). Drops of 30 percent or more occurred in 1994 and 1996. This use reached a peak in 1998, dropped 15 percent in 1999, then rebounded in 2000, nearly to 1998 levels. Salt Creek-specific concession vehicle revenue is assumed to correlate to use.

Annual Needles-wide concession vehicle RVDs ranged from 664 to 1078 between 1991 and 2000, fluctuating an average of 12 percent per year up or down over this period (Figures 6 and 7). The biggest changes in this period were in 1992 (26 percent decrease), and 1998 (23 percent decrease). Needles-wide use has dropped each year since 1997. Both Needles-wide and Salt Creek-specific vehicle RVDs dropped substantially in 2001, consistent with national travel trends.

Over the years since 1994, Salt Creek use has generated an increasing portion of the total Needles concession vehicle use (Figure 6). Salt Creek vehicle use has increased, but total Needles concession vehicle use has decreased.

Concession vehicle vs. nonvehicle trend, Needles: Like concession vehicle use, non-vehicle (backpacking and mountain bike) commercial RVDs in the Needles declined from 1997 through 1999, the years immediately before and after the vehicle prohibition above Peekaboo (Figure 7). This may indicate a broader tourism trend affecting both of these sectors.

Figure 6. Recreation Visitor-Days (Needles Dist. and Salt Cr.) vs. Gross Receipts (Parkwide), Commercial Four-wheel-drive Vehicle Tours



Commercial RVDS from all activities, Needles-wide: Total commercial RVDs in Needles (which includes vehicle, backpack, and mountain bike trips) have trended downward since 1993, except for increases in 1996 and 2000 which were driven primarily by increases in the backpacking sector (Figure 7). Total Needles commercial RVDs ranged from 1473 to 2715 between 1991 and 2000; they fluctuated an average of 17 percent per year from 1991 to 1997 and 18 percent per year from 1998 to 2000. Non-vehicle trips (backpack or bike) typically generate a larger portion (average 60 percent) of the total commercial Needles RVDs than vehicle trips, but also fluctuate more from year to year, averaging over 30 percent change up or down each year since 1992.

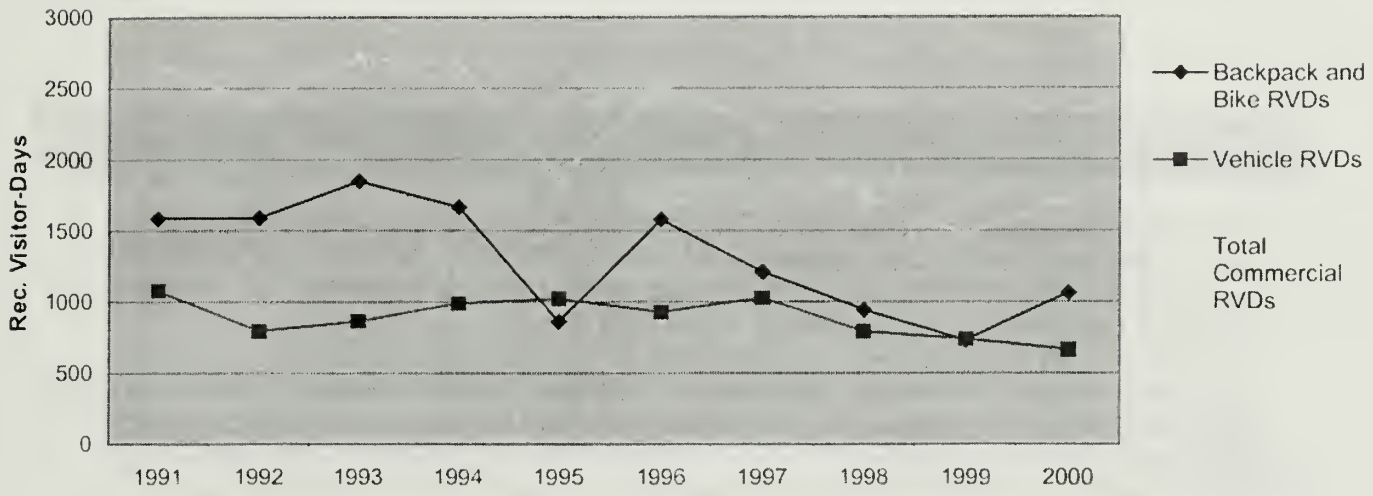
Gross receipts

The NPS only has gross receipts records for each company and/or type of activity on a parkwide basis; revenue from specific trip destinations or park districts is not broken out separately.

Vehicle trips only: Gross receipts from commercial vehicle tours (parkwide) ranged from $240,000 to $313,000 between 1994 and 2000 (Figure 6). (Gross revenue increased over 400 percent from 1993 to 1994, probably due to changes in accounting methods.) After increases in 1995 and 1996, revenue from vehicle trips declined each year from 1996 through 1999, then increased in 2000. Annual fluctuations averaged 6 percent up or down between 1994 and 1997, and 8 percent from 1998 to 2000. The largest change during this period was a 15 percent decline in 1998, the year vehicle travel was enjoined above Peekaboo. Declines also occurred in the previous year (5 percent) and subsequent year (4 percent). Corresponding declines occurred from 1997 to 1998 in gross revenue from non-vehicle trips (backpacking and bike) , which generally did not use this section of Salt Creek, so the decline in vehicle receipts in this year may

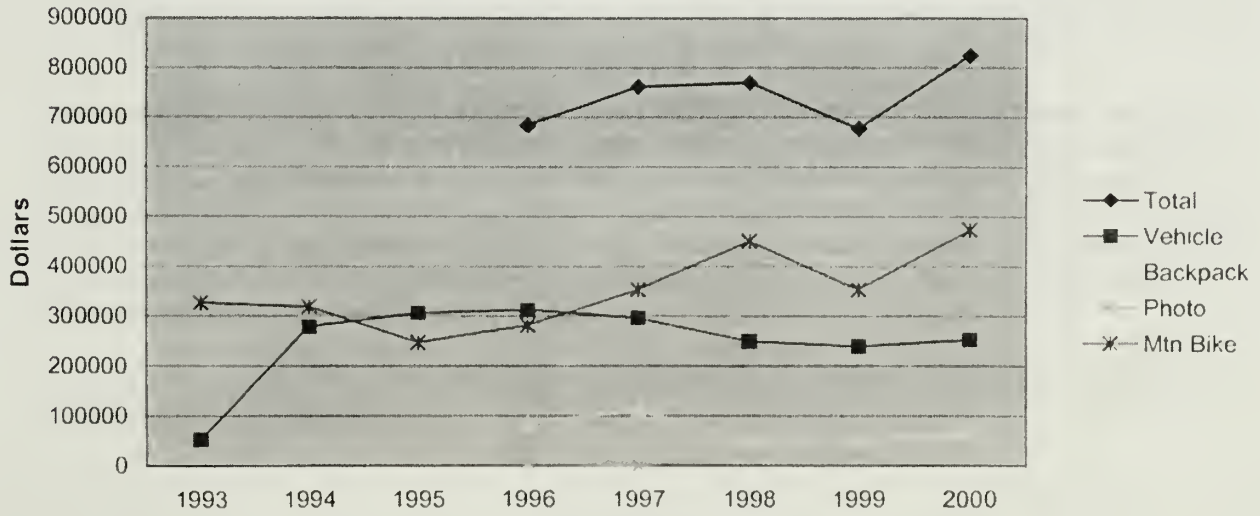
have been influenced by broader tourism trends. In 2000, gross receipts from vehicle trips rose back above the 1998 level, though vehicles were still prohibited above Peekaboo.

Figure 7. Commercial Recreation Visitor-Days, Vehicle, Backpack and Mountain Bike Trips, Needles District



Though concession revenue from Salt Creek vehicle trips is not broken out separately, recreation visitor-day records indicate that Salt Creek trips (including Horse Canyon) have accounted for an increasing portion of the total Needles concession vehicle trips since 1994. As discussed above, total Needles concession vehicle use has decreased since 1997, though Salt Creek concession vehicle use has increased. Concurrently, there has been a parkwide decrease in revenue from vehicle use. In recent years (1998-2000) parkwide vehicle revenues have parallelled Salt Creek vehicle day use; in previous years (before 1998) a connection was not evident (vehicle gross revenue went down in years when Salt Creek use went up, and vice versa.

Figure 8. Commercial Gross Receipts, Land Based, CANY



All activities: Total gross revenue from all land-based (vs. river-based) commercial tour services in Canyonlands has ranged from about $680,000 to $820,000 between 1996 and 2000 (Figure 8). The portion contributed by vehicle tours has ranged from 30 to 45 percent since 1996, while the share from backpack trips has ranged from 8 to 15 percent. The largest contribution to land based commercial tour revenue during this period has come from mountain bike tours, which have ranged from 41 to 59 percent of the total land-based revenue. Total land-based revenue increased one percent in 1998, the year of the vehicle injunction, decreased 12 percent in 1999, then increased 22 percent in 2000.

3.2.8 Wilderness

The Salt Creek jeep road is bordered on both sides by land recommended for wildemess designation by the NPS and the Secretary of Interior (NPS 1974). NPS policy is that lands recommended for wilderness are to be managed to maintain their wilderness characteristics until Congress acts on the recommendations (NPS 2001, 1999).

The Salt Creek road is surrounded by the Needles recommended wilderness unit, encompassing approximately 67,000 acres, which is bordered by the park boundary on the east, south and southwest, and various roads on the north and west. The Canyonlands wilderness recommendation (NPS 1974) describes non-wilderness road corridors as follows:

> The recommended wilderness is approximately 300 feet from the centerline of major roads, and approximately 150 feet from the centerline of other other roads, except where topographic features provide a more logical wilderness boundary or where more non-wilderness space is needed. Any setback from a road centerline is approximate; the wilderness will be described legally by a topographic or general land-survey description.

4. ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This chapter discusses the environmental consequences of implementing the alternatives described in Chapter 2. The analysis discloses the impacts to resources identified as impact topics in Chapter 1 and provides the scientific and analytical basis for the comparison of the alternatives. The following types of effects, or impacts, are analyzed, as defined by the Council on Environmental Quality (CEQ) regulations (40 CFR 1508.7-1508.8) implementing the National Environmental Policy Act (NEPA; 42 USC 4322 *et seq.*):

- **Direct Effects:** Effects caused by the action and occurring at the same time and place.
- **Indirect Effects:** Effects caused by the action but occurring later in time or further removed in distance.
- **Cumulative Effects:** The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. The CEQ regulations (40 CFR 1500-1508) implementing NEPA require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts were determined by combining the incremental impacts of each of the four alternatives with other past, present and reasonably foreseeable future actions. Such actions that pertain to individual impact topics are described in the cumulative impacts sections under individual impact topics.

Direct, indirect, and cumulative effects analyses include discussions on adverse and beneficial effects, and short and long-term effects, on resources. If impacts or effects are not specifically characterized as "beneficial" or "positive," they are meant to be understood as "adverse" or "negative." Following the discussion of the impacts of each alternative on each impact topic, a brief "conclusions" section summarizes all major findings, including whether or not an impairment of resources or values, as defined in Management Policies 2001 (Section 1.4, USDI National Park Service 2001) is likely to or would occur.

A body of laws, regulations and policies provide direction for analysis of impacts. These are summarized in Chapter 6.

4.2 Impact Topics

Summaries of impacts from each alternative are compared in Table 2.

Table 2. Comparison of Impacts by Alternative.
Note: impacts are adverse unless specifically noted as beneficial

Impact Topic	Alternatives			
	A Vehicle access all year by permit system	B Vehicle access part-year by permit system	C Road realigned; vehicle access all year by permit system	D Vehicles prohibited all year
THREATENED, ENDANGERED AND SENSITIVE SPECIES	Minor direct and indirect impacts would continue long term. Moderate cumulative effects	Negligible direct impacts; indirect impacts would be long term and minor, as in Alt. A. Breeding season impacts would be reduced; other impacts would remain.	Minor direct and indirect impacts would continue long term, as in Alt. A. Moderate cumulative effects.	Minor direct beneficial impacts of long term duration, minor to moderate long term indirect beneficial impacts.
WILDLIFE	Minor to moderate direct impacts of intermediate to long term duration. Minor to moderate indirect impacts would continue long term. Major impacts to individuals in cases of death or injury	Minor direct impacts of intermediate to long term duration. Minor to moderate indirect impacts would continue long term, as in Alt. A. Breeding season impacts would be reduced; other impacts would remain	Minor direct impacts of intermediate to long term duration. Major impacts where death or injury is involved. Minor to moderate indirect impacts would continue long term, as in Alt. A. Lower amphibian impacts where road is removed from creek	Minor to moderate direct beneficial impacts of long term duration, especially to amphibians. Minor to moderate indirect beneficial long term impacts, primarily due to habitat gains and lower general disturbance level.
NATURAL SOUNDSCAPE	Moderate direct impacts of intermediate duration, site-specific. Cumulative impacts may occur due to presence of overflights	Moderate direct impacts of intermediate duration, occurring only when open to vehicles, as in Alt. A.	Moderate direct impacts of intermediate duration, as in Alt. A. Cumulative impacts may occur due to presence of overflights	Moderate direct beneficial impacts of long term duration. Except for overflights, only sounds from hikers would impact the natural soundscape
RECREATION EXPERIENCE	Moderate direct beneficial impacts of intermediate duration for general accessibility, and minor negative impacts of short to intermediate term for hikers	Moderate direct impacts of long term duration for general accessibility, due to limited open period. Minor negative impacts of intermediate term for hikers.	Moderate direct beneficial impacts of intermediate duration for general accessibility, and minor negative impacts of intermediate term for hikers, as in Alt. A	Moderate to major direct impacts of long term duration for general accessibility; mostly positive long term moderate direct impacts for hiking
ARCHEO-LOGICAL RESOURCES	Moderate direct and indirect impacts by vehicles crossing archeological sites (damaged artifacts, increased erosion, and disturbed deposits). Minor impacts from pedestrian use	Moderate direct and indirect impacts by vehicles crossing archeological sites (damaged artifacts, increased erosion, and disturbed deposits). Minor impacts from pedestrian use	Minor to moderate direct and indirect impacts by new road construction upon individual archeological sites and Salt Creek Archeological District. Minor impacts from pedestrian use	Negligible direct impacts on archeological sites from pedestrian use

Impact Topic	Alternatives			
	A Vehicle access all year by permit system	B Vehicle access part-year by permit system	C Road realigned; vehicle access all year by permit system	D Vehicles prohibited all year
RIPARIAN/ WETLAND ECOSYSTEM				
• Functioning Condition	Minor to moderate direct impact continues long term. Condition would not improve. Risk of major indirect impact from regularly-recurring flooding (5 – 20 year recurrence intervals) continues long term.	Minor direct impact continues long term. Condition would not improve to properly functioning condition (PFC) until at least the long term, if ever. Risk of major indirect impact from regularly-recurring flooding (5 – 20 year recurrence intervals) continues unless/until condition improves to PFC.	Moderate direct impact in short-intermediate term; may decrease to minor impact in long term. Additional channel instability and sediment generation may offset improvements in channel sections where road sections are rerouted. Functioning condition would not improve. Risk of major indirect impact from regularly-recurring flooding (5 – 20 year recurrence intervals) continues long term.	Moderate direct beneficial effect in short-intermediate term; major direct beneficial effect in intermediate-long term. Condition would improve to properly functioning condition (PFC) in intermediate to long term. Risk of major indirect adverse impact from regularly-recurring flooding (5 – 20 year recurrence intervals) abates as riparian condition improves.
• Area (acreage) of riparian/ wetland disturbance	Minor direct impact, and risk of major indirect impact, continues long-term. Area of direct riparian/wetland disturbance increased by less than 1 acre, to about 3 acres.	Minor direct impact continues long term. Area of direct riparian/wetland disturbance increased by less than 1 acre, to about 3 acres. Risk of major indirect impact would not decrease before the long term, if ever.	Minor direct adverse impact in short-intermediate term; minor direct beneficial effect in intermediate-long term. Area of direct riparian/wetland disturbance reduced by about 1.7 acres, to about 4 acres. Risk of major indirect impact continues long term.	Moderate direct beneficial effect in intermediate-long term. Area of direct riparian/wetland disturbance reduced by about 4 acres, to about 1.3 acres. Risk of major indirect impact abates in intermediate to long term.
• Water Quality	Moderate direct adverse impact, and risk of major indirect adverse impact, continues long- term.	Minor to moderate, direct, beneficial effect continues long term. Further improvement unlikely before long term, if ever. Risk of major indirect adverse impact continues unless/until riparian condition improves to PFC.	Moderate direct adverse impact, and risk of major indirect adverse impact, continues long- term.	Moderate direct beneficial effect continues long-term. Risk of major indirect adverse impact begins declining in short term.
ECONOMICS	Negligible effects continue long-term	Negligible effects continue long-term	Negligible effects continue long- term	Negligible effects continue long- term
WILDERNESS	Negligible effects	Negligible effects	Moderate adverse impacts in long term	Minor beneficial effects in long term

4.2.1 Threatened, Endangered and Sensitive Species

4.2.1.1 Introduction

Certain of the alternatives described in Section 2 may affect species protected by the federal Endangered Species Act (ESA), or otherwise designated as species of special concern. Those potential effects are described in the following evaluations.

In addition to other laws and regulations protecting park resources (see Chapter 6), the Endangered Species Act of 1973, as amended, is the primary guide for NPS actions involving federally listed threatened and endangered species.

4.2.1.2 Methodology for Evaluating Impacts and Significance (Context, Duration, Intensity)

Various information sources have been used to determine impacts and significance for the affected Threatened, Endangered, and Sensitive (T&E) resources. These consist primarily of published literature such as species research, recovery plans and federal register notices, as well as monitoring data and personal observations. Past research and the ongoing park monitoring program has accumulated a considerable amount of data on peregrine falcons and Mexican spotted owls, in particular.

The following definitions apply to impact descriptions for the T&E category:

Duration:

- Short-term: effect of each impact lasting a few hours or less
- Intermediate: lasting from a few hours to a few days
- Long-term: lasting from a few days to permanently

Intensity:

- Negligible: no measurable impacts to T&E species, their habitat, or the natural processes sustaining them. Would probably result in a "no effect" determination under the ESA.

- Minor: impacts are detectable, but not expected to be outside the natural range of variability for species, their habitats, or the natural processes sustaining them. Population numbers remain stable and viable. Occasional responses to disturbance by some individuals are expected, but without measurable interference with survival, reproduction, or other factors affecting population levels. Sufficient habitat remains to maintain viability of species in the park. Would probably result in a "may affect/not likely to adversely affect" determination under the ESA.

- Moderate: impacts on species, their habitats, or the natural processes sustaining them are detectable, and expected to be outside the natural range of variability for short periods of time. Population numbers and structure may undergo measurable changes, but remain stable and viable. Frequent responses to disturbance by some individuals are expected, with some local impacts to survival, reproduction, or other factors affecting population levels. Sufficient habitat remains to maintain viability of species in the park. Would probably result in a "likely to adversely affect" determination under the ESA.

- Major: impacts on species, their habitats, or the natural processes sustaining them are easily detectable and well outside the natural range of variability. Population numbers are depressed and population structure is altered. Frequent response to disturbance by individuals or groups, with impacts on survival, reproduction, or other factors resulting in depressed population levels. Habitat changes may affect the viability of species in the park. Would result in a "likely to adversely affect" or possibly a "could jeopardize the continued existence" determination.

4.2.1.3 Alternative Comparison

4.2.1.3.1 Alternative A – No Action (Vehicle Access All Year by Permit System)

Direct and Indirect Effects

Mexican Spotted Owl

The Mexican spotted owl (MSO) was federally listed as a threatened species in April, 1993. In 1995, the USFWS published a recovery plan for the species, which outlined the steps necessary to remove the owl from the list of threatened species. Allowing vehicle access from Peekaboo Camp to Angel Arch Canyon under the permit system initiated by the 1995 BMP is consistent with recreation management recommendations in the 1995 Mexican Spotted Owl Recovery Plan. During informal consultation under Section 7 of the Endangered Species Act, the USFWS has concurred with previous NPS findings that the current level of motorized recreational activity confined to a single roadway, and other presently authorized recreational uses, are not likely to adversely affect the owls or their designated critical habitat. For purposes of the ESA, the USFWS draws this conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial (USFWS, 1998).

Pedestrian movements have generally been found to be more disturbing to raptors and other birds than some other recreational activities such as motorized use (Belanger and Bedard 1989, McGarigal et al. 1991, Holmes et al. 1993). Research to investigate the impacts of hiking on MSO occupying nesting territories in Canyonlands National Park indicated that infrequent hiking activity has little impact on roosting owls, and exclusion of hiking activity during nesting season was not considered necessary, given the current level of hiking use in the study area (Swarthout, 2001).

The location of owls predominantly in the side canyons adjacent to Salt Creek Canyon may be attributed to the more favorable physical habitat characteristics of those locations (Willey 1998), or may be an indirect reaction by the owls to the presence of vehicles and pedestrian traffic in the main canyon. The presence of the road may also be impeding development of a more extensive

riparian zone in the canyon bottom and thereby limiting potential habitat for owls (see section 4.2.6 Riparian/Wetland Ecosystem).

Continued use of the Salt Creek Road at the relatively low levels of vehicle and pedestrian activity associated with this alternative would result in direct and indirect MSO impacts that are site-specific, long-term, and of negligible to minor intensity.

Peregrine Falcon

Nesting high on the cliffs in side canyons of Salt Creek, peregrine falcons have relatively little susceptibility to direct disturbance from low levels of vehicle use on the canyon floor, although they use riparian habitats extensively for feeding. Continued vehicle access will facilitate casual exploration of the main canyon and side canyons, which may result in higher levels of human pedestrian activity near falcon nests. Falcons have nested in the Salt Creek Canyon vicinity for many years, and have apparently become accustomed to past levels of recreational activity at or above those that are likely to occur under this alternative. However, this activity could be preventing nesting by falcons in the main canyon. The presence of the road may also be impeding development of a more extensive riparian zone in the canyon bottom and thereby limiting potential habitat for falcons (see section 4.2.6 Riparian/Wetland Ecosystem).

Continued use of the Salt Creek Road at the relatively low levels of vehicle and pedestrian activity associated with this alternative would result in direct and indirect peregrine falcon impacts that are site-specific, long-term, and of negligible to minor intensity.

Other State-listed Birds

Three other state-listed sensitive species, the common yellowthroat, the blue grosbeak, and the Lewis's Woodpecker are known to occur in Salt Creek Canyon. The common yellowthroat and the blue grosbeak are known to nest in the canyon or surrounding area. Some indirect loss of potential habitat for these birds is occurring by keeping the road open and preventing regrowth of vegetation in the roadway.

These species are known to nest and forage in relatively close proximity to human development, and are therefore capable of becoming somewhat tolerant of human presence and activity. Therefore, the level of use proposed in the alternatives presented in this plan would be expected to have direct and indirect impacts on these species that are negative, site-specific, long-term, and of minor intensity.

Cumulative Effects

On public lands surrounding the park there has in recent decades been a significant increase in general recreational activity, hunting, backcountry road use, off-road vehicle use, and energy development. This can place increased stress on wildlife species that are sensitive to human disturbance. Under this scenario, the role of the park as a refuge becomes more critical. Retaining a potentially disturbing feature like a road in an important wildlife habitat type such as the riparian area of Salt Creek Canyon could reduce the refuge quality of the area for displaced wildlife, including T&E species.

The existence of the road today is the result of past management decisions. The presence of the road may be impeding development of a more extensive riparian zone in the canyon bottom and thereby limiting potential habitat for T&E species (see section 4.2.6 Riparian/Wetland

Ecosystem).

The cumulative effects on of this alternative on T&E species, in combination with other past, present, and reasonably foreseeable future actions described in this section, are likely to be negative, regional, long-term and of moderate intensity.

Conclusion

Because of the continued presence of the road and motorized traffic, direct impacts of this alternative on threatened, endangered, and sensitive species are expected to be negative, site-specific, long-term, and of negligible to minor intensity. Indirect impacts could be negative, canyon-wide, long-term and of negligible to minor intensity. Cumulative effects are likely to be negative, regional, long term and of moderate intensity. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.1.3.2 Alternative B (Vehicle Access Part Year by Permit System)

Direct and Indirect Effects

Mexican Spotted Owl

Direct impacts would be negligible; indirect impacts would be minor due to habitat effects similar to those described in Alternative A. This use, limited to fall and winter, would be outside of the MSO nesting season.

Peregrine Falcons

Direct impacts would be negligible; indirect impacts would be minor due to habitat effects similar to those described in Alternative A. This use would be outside of peregrine nesting season. Falcons migrate out of the area in the fall, and are unlikely to be present after mid-October.

Other State-listed Birds

Direct impacts would be negligible; indirect impacts would be minor due to habitat effects similar to those described in Alternative A. These birds migrate and most would be out of the area by mid-September.

Cumulative Effects

The existence of the road today is the result of past management decisions. The presence of the road may be impeding development of a more extensive riparian zone in the canyon bottom and thereby limiting potential habitat for T&E species (see section 4.2.6 Riparian/Wetland Ecosystem).

The cumulative impacts of this alternative, in combination with other past, present, and reasonably foreseeable future actions, would be similar to those described for Alternative A,

although at a lower level of intensity for direct disturbance. Factor impeding development of a more extensive riparian zone would remain.

Conclusion

Direct impacts of this alternative on threatened, endangered, and sensitive species are expected to be negative, site-specific, short-term, and of negligible intensity. Indirect impacts could be negative, canyon-wide, long-term and of minor intensity. Cumulative effects are likely to be negative, regional, long term and of moderate intensity. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.1.3.3 Alternative C (Road Realignment)

Direct and Indirect Effects

General

Many species become accustomed to various levels of disturbance over time. The changes caused by relocation of the road could alarm individuals of certain species. They may quickly become accustomed to the new route, or it could cause individuals to leave the area temporarily or permanently.

Despite partial realignment, the road would remain in the creek bed or the riparian zone for a substantial distance. As with Alternatives A and B, this could affect potential for natural development of a more extensive riparian/wetland system in the canyon bottom.

Mexican Spotted Owls

The road and associated motorized traffic would still be present in the canyon bottom. Impacts would be similar to Alternative A.

Peregrine Falcons

The road and associated motorized traffic would still be present in the canyon bottom. Impacts would be similar to Alternative A.

Other State-listed Birds

The road and associated motorized traffic would still be present in the canyon bottom. Impacts would be similar to Alternative A.

Cumulative Effects

The cumulative impacts of this alternative, in combination with other past, present, and reasonably foreseeable future actions, are expected to be similar to those described for Alternative A.

Conclusion

The road and associated motorized traffic would still be present in the canyon bottom. Therefore, direct impacts of this alternative on threatened, endangered, and sensitive species are expected to be negative, site-specific, long-term, and of negligible to minor intensity. Indirect impacts could be negative, canyon-wide, long-term and of negligible to minor intensity. Cumulative effects are likely to be negative, regional, long term and of moderate intensity. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.1.3.4 Alternative D (Vehicles Prohibited All Year)

Direct and Indirect Effects

General

Many of the negative impacts attributed to Alternatives A, B, and C would be eliminated or reduced by excluding vehicles. Negative impacts from pedestrian use would remain. Some decrease in overall disturbance should result during the day with the removal of vehicle-related pedestrian use, while some increase in overnight use by backpackers may occur.

Mexican Spotted Owls

As an indirect positive effect, some increase in foraging habitat may result as the roadway revegetates. Some direct positive effect may occur due to removal of vehicle traffic and reduction of pedestrian use associated with vehicle access. The overall effect would be canyon-wide, long-term, and of minor intensity.

Peregrine Falcons

As an indirect positive effect, some increase in foraging habitat may result as the roadway revegetates. Some direct positive effect may occur due to removal of vehicle traffic and reduction of pedestrian use associated with vehicle access. The overall effect would be canyon-wide, long-term, and of minor intensity.

Other State-listed Birds

As an indirect positive effect, some increase in nesting and foraging habitat may result as the roadway revegetates. Some positive direct effect may occur due to elimination of potential disturbance from vehicles and reduction of pedestrian use. The overall effect would be positive, canyon-wide, long-term, and of minor intensity.

Cumulative Effects

The implementation of the BMP in 1995 had the effect of regulating and limiting backcountry use in the park. This may have a positive impact on T&E species by limiting frequency and intensity of disturbance from recreational activities, including hiking and backcountry camping. Another

cumulative effect of this alternative would be to allow the creek and associated riparian zone to move toward a more natural profile and assume a proper functioning condition. This is expected to result in more extensive wetland and riparian zone in the canyon bottom, which would provide enhanced habitat values for the species of concern. This would be a positive canyon-wide long term impact of moderate intensity. Therefore, the cumulative effects of this alternative, in combination with other past, present, and reasonably foreseeable future actions described in this paragraph, are expected to positive, long term and moderate.

Conclusion

This alternative would result in elimination of the road, with a trail remaining in its place. Motorized traffic would no longer be present in the canyon bottom. Direct impacts of this alternative on threatened, endangered, and sensitive species are expected to be positive, site-specific, long-term, and of minor intensity. Indirect impacts could be positive, canyon-wide, long-term and minor. Cumulative effects are expected to be positive, long term and moderate. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the parks's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.2 Wildlife

4.2.2.1 Introduction

Salt Creek Canyon contains a rich assemblage of wildlife species. Potential impacts on wildlife are examined here at the individual and population level.

NPS regulations provide protection to wildlife from feeding, touching, teasing, frightening, or intentional disturbing of nesting, breeding, or other activities (36 CFR 2.2). Policy requires consideration of impacts to wildlife in planning and conducting park management activities, including visitor use management. Executive Order 13186 requires Federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to consult with the U.S. Fish and Wildlife Service. See Chapter 6 for other laws, regulations and policies that may affect wildlife.

4.2.2.2 Methodology for Evaluating Impacts and Significance (Context, Duration, Intensity)

A variety of information sources have been used to determine impacts and significance for the affected wildlife resources. These consisted primarily of general published literature such as species research and life history studies, as well as monitoring data, species lists and personal

observations. Sources specific to Canyonlands National Park or the Salt Creek area included, for example, a study of human impacts on aquatic and riparian resources in Salt Creek (Mitchell and Woodward 1993), monitoring results (Schelz 2001; Daw 2001; Graham 2001), and input from subject matter experts outside the agency. Information sources are cited in the text and described in Section 7 of this EA.

The following definitions apply to impact descriptions for the Wildlife category:

Duration:

- Short-term: effect of each impact lasting a few hours or less
- Intermediate: lasting from a few hours to a few days
- Long-term: lasting from a few days to permanently

Intensity:

Impacts are rated at the following levels if they appear to meet one or more of the criteria in the threshold description for that level:

- Negligible: no measurable impacts to wildlife species, their habitat, or the natural processes sustaining them.

- Minor: impacts are detectable, but not expected to be outside the natural range of variability for wildlife species, their habitats, or the natural processes sustaining them. Population numbers and structure may undergo small changes, but remain stable and viable. Occasional responses to disturbance by some individuals are expected, but without measurable interference with survival, reproduction, or other factors affecting population levels. Sufficient habitat remains to maintain viability of all species. Impacts are outside of critical reproduction periods.

- Moderate: impacts on species, their habitats, or the natural processes sustaining them are detectable, and expected to be outside the natural range of variability for short periods of time. Population numbers and structure may undergo measurable changes, but remain stable and viable. Frequent responses to disturbance by some individuals are expected, with some local impacts to survival, reproduction, or other factors affecting population levels. Sufficient habitat remains to maintain viability of all species. Some impacts may occur during critical periods of reproduction or in key habitat for sensitive native species.

- Major: impacts on species, their habitats, or the natural processes sustaining them are easily detectable and well outside the natural range of variability. Population numbers are depressed and population structure is altered. Frequent response to disturbance by individuals or groups, with impacts on survival, reproduction, or other factors resulting in depressed population levels. Large scale relocation of species may occur. Habitat changes may affect the viability of some species.

4.2.2.3 Alternative Comparison

4.2.2.3.1 Alternative A - No Action (Vehicle Access All Year by Permit System)

Direct and Indirect Effects

General

Mechanical impacts from wheeled vehicles are known to result in crushing of individual organisms such as small mammals, amphibians (larval and adult stages) and reptiles (especially snakes). The relatively slow speed of vehicle operation in Salt Creek Canyon would, however, provide an escape opportunity for most vertebrate wildlife species. The physical presence and passage of vehicles and pedestrians in the canyon also presents some level of disturbance that can force a change in feeding, resting and hiding activity patterns. These changes can have an adverse effect on individuals that increases with frequency of occurrence (Knight and Cole 1991). Some individuals or groups of organisms can become accustomed or habituated to certain levels and frequency of disturbance, and cease to exhibit any unusual response (Whittaker and Knight 1998). Roads are also well known to play a role in habitat fragmentation and disruption of wildlife movement corridors (Gibbs 1998), although most negative impacts are attributed to roads designed and traveled at a level far higher than a typical "two-track" such as the Salt Creek road.

Birds

Motorized use of the road from Peekaboo to Angel Arch Canyon is unlikely to have a measurable direct impact on the bird populations in the area. However, vehicle access to the area could produce a higher level of daytime pedestrian use than if the road were closed to motorized use. Those accessing the canyon by vehicle have time within a single day to traverse the road and include frequent stops to get out and explore the canyon on foot. Pedestrian movements have been found to be more disturbing to raptors and other birds than other recreational activities such as motorized use. (Belanger and Bedard 1989, McGarigal et al. 1991, Holmes et al. 1993). To the extent vehicles facilitate daytime pedestrian use, this is a negative, canyon-wide, long term, minor indirect effect.

Keeping the road corridor open for vehicle passage has the indirect effect of a reduction in potential vegetation volume, which has been correlated with breeding bird densities (Mills et al. 1991). Schelz (2001) calculated that potential breeding bird density may be reduced by as many as 31 pairs due to the reduction in vegetation volume represented by the width of the road corridor.

The presence of the road and associated motorized and pedestrian traffic under this alternative would be expected to have negligible direct impacts on the bird populations. Indirect impacts, primarily related to habitat effects, could be negative, long-term, and minor.

Amphibians and Reptiles

Critical amphibian habitat components such as type and density of streamside vegetation and persistent surface water for breeding are in poor condition in the affected area (Drost 2001). Research and monitoring of amphibian populations in Salt Creek Canyon is ongoing, but to date no consistent relationship between open-road and closed-road areas has been established. Some abundance correlation may exist between open-road and closed-road areas for certain

species, although the long-term and population-level significance of this correlation is unknown. (Mitchell and Woodward 1993). One species, the tiger salamander *(Ambystoma tigrinum)*, has been found only in Upper Salt Creek, above the area where the road has been open.

Numerous instances of direct impact to amphibian larval and adult stages have been observed. These occur when individual adults are run over by vehicles, and tadpoles are crushed or washed out of pools by passing vehicles. Reptiles are also susceptible to direct vehicle impacts, and have been observed crushed in the roadway (Graham 2001).

The presence of the road and associated motorized and pedestrian traffic under this alternative would have negative direct impacts on individual organisms and small groups in the case of injury or death by crushing, that would be site-specific, long-term, and of major intensity. However, long term alteration of overall population structure is unlikely. Therefore, direct impacts at the population level would be negative, site-specific, of intermediate duration, and of minor intensity. Indirect impacts due to habitat effects would be negative, site-specific, of long term duration, and of minor intensity.

Mammals

The presence of humans is known to influence the activities of most wild mammal species (Elmore and Workman 1978), and it is likely that human use of Salt Creek Canyon results in some level of disturbance and stress to the natural routine of mammals using the area. Continuation of vehicle access under this alternative would result in a relatively high amount of human use in the area, and therefore a higher frequency of direct and indirect contact with mammals. The higher the level of human use, the more pronounced the disturbance is likely to be. This disturbance can take the form of total avoidance, disruption of travel or foraging activities, or attraction out of curiosity or as a source of food from litter or poor food storage. Any of these disturbances could lead to harm, which is likely to be manifested in one of two ways: 1) by increasing risk of death for the affected animal as a consequence of habituation to humans, or 2) by decreasing fecundity of the affected animal as a consequence of increased energy expenditure and decreased access to important resources (Mattson 2001; Papouchis et al. 2001). Mitchell and Woodward (1993) surveyed small mammal populations in roaded and unroaded sections of Salt Creek Canyon, and found significantly higher numbers of most species in the unroaded sections. This would indicate the potential for an indirect population-level negative effect on small mammals from continued use of the roadway.

While direct impacts of this alternative on individual mammals or small groups would be negative, major and long-term if death or injury is involved, long-term alteration of overall population structure is unlikely. Therefore, the direct impact on mammal populations would be negative, site-specific, of intermediate duration, and of minor to moderate intensity – mostly due to disturbance from the presence of humans and vehicles. Indirect impacts in the form of habitat effects would be negative, site-specific, of long term duration, and of minor to moderate intensity.

Cumulative Effects

On public lands surrounding the park there has in recent decades been a significant increase in energy development, general recreational activity, hunting, backcountry road use and off-road vehicle use. While some wildlife populations have actually increased during this period, the growth in recreation and other human activity can place increased stress on wildlife species that are sensitive to such disturbance. Under this scenario, the role of the park as a refuge becomes more critical. Retaining a potentially disturbing feature such as a road in an important wildlife

habitat type like the riparian area of Salt Creek Canyon could reduce the refuge quality of the area for displaced wildlife.

The existence of the road today is the result of past management decisions. The presence of the road may be impeding development of a more extensive riparian zone in the canyon bottom and thereby limiting potential wildlife habitat (see section 4.2.6 Riparian/Wetland Ecosystem).

The cumulative effects of this alternative, in combination with other past, present, and reasonably foreseeable future actions described in this paragraph, are expected to be negative, regional, long-term and of minor to moderate intensity.

Conclusion

The direct impacts of the presence of the road and related motorized and pedestrian traffic on wildlife in Salt Creek Canyon are, depending on the species, expected to be negative, site-specific, of intermediate to long-term duration, and of minor to major intensity. Indirect impacts would be negative, canyon-wide, of long term duration and minor to moderate intensity. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.2.3.2 Alternative B (Vehicle Access Part Year by Permit System)

Direct and Indirect Effects

General

Impacts resulting from this alternative would likely be similar to those discussed for Alternative A, although the limited season of use would reduce the scope and duration of certain types of direct disturbance impacts by as much as 75%. However, only a few passes of a vehicle through a riparian or wetland habitat are sufficient to retard any appreciable vegetation recovery for the year (see section 4.2.6.2.2), so any indirect impacts related to reduction in potential riparian habitat or other long-term habitat effects would remain.

Birds

This alternative would remove any potential direct impacts from disturbance caused by vehicle presence and associated human activity during the breeding season. It would not affect the indirect impact of potential loss of breeding bird density resulting from reduction in vegetation volume due to the road corridor, since potential for destruction of vegetation cover varies little with the season. This alternative would be expected to have negligible direct impacts on the bird populations. Indirect impacts, primarily due to habitat effects, could be negative, long-term, and minor.

Amphibians and Reptiles

Breeding and general activity of amphibians and reptiles would be reduced in the late fall through winter, when colder weather causes dormancy. This would eliminate the likelihood that eggs,

larvae or adults would be destroyed by crushing or otherwise directly disturbed by the presence of vehicles. Indirect impacts (physical changes in riparian/wetland area or stream channel alterations caused by vehicles) would not be reduced by this alternative, since most impacts occur with the first few passes.

This alternative would be expected to have negligible direct impacts on amphibian and reptile populations. Indirect impacts from habitat effects would remain, and would be negative, site-specific, of long term duration, and of minor intensity.

Mammals

During the period in which the road is open, nature of impacts to mammals would be similar to those outlined in Alternative A. By having the road open only in the fall and winter, potential direct impacts on breeding activities and rearing of young should be reduced. Negative habitat effects would remain. Likelihood of direct impacts on individuals in the form of death or injury would be reduced from the levels expected under Alternative A. The direct impact on mammal populations would be negative, site-specific, of intermediate duration, and of minor intensity. Indirect impacts (habitat effects) would be negative, site-specific, of long term duration, and of minor to moderate intensity.

Cumulative Effects

Cumulative effects would be similar to those outlined for Alternative A. Retaining a potentially disturbing feature such as a road in an important wildlife habitat type like the riparian area of Salt Creek Canyon could reduce the refuge quality of the area for displaced wildlife. Therefore, the cumulative effects of this alternative, in combination with other past, present, and reasonably foreseeable future actions described in this paragraph, are expected to be negative, canyon-wide, long-term and of minor to moderate intensity.

Conclusion

The road and its associated habitat effects would remain under this alternative. By permitting motorized use of the road only during fall and winter, direct impacts to wildlife may be somewhat reduced. Therefore, direct impacts of this alternative on wildlife species are expected to be negative, site-specific to regional, of intermediate to long-term duration, and of minor intensity. Indirect impacts would be negative, canyon-wide, long term and of minor to moderate intensity. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.2.3.3. Alternative C (Road Realignment)

Direct and Indirect Effects

Birds

Impacts would likely be similar to those outlined in Alternative A. Routing the road out of the creek and riparian zone where possible would result in restoration of riparian vegetation at those

locations. This would result in an increased vegetation volume that could support additional breeding birds. Other road-related impacts would remain. This alternative would be expected to have negligible direct impacts on the bird populations. Indirect impacts from remaining habitat effects could be negative, long-term, and minor.

Amphibians and Reptiles

By routing the road out of the creek bed where possible, direct impacts to larval and adult amphibians utilizing standing water should be reduced from the levels experienced in Alternative A. Impacts would still be present at those locations where rerouting was not feasible. Impacts to upland reptiles may actually increase under this alternative.

This alternative would be expected to have negative direct impacts on amphibian and reptile populations that are site-specific, of intermediate duration, and of minor intensity. Impacts to individuals and small groups would be site-specific, long-term and major where death or injury is involved.

Mammals

Rerouting the road is unlikely to change the impacts to mammals. The vehicles and associated human activity would remain present in the canyon, resulting in the impacts outlined under Alternative A.

While direct impacts of this alternative on individuals and small groups would be negative, major and long-term if death or injury is involved, the direct impact on mammal populations would be negative, site-specific, of intermediate duration, and of minor intensity. Indirect impacts would be negative, site-specific, of long term duration, and of minor to moderate intensity.

Cumulative Effects

Cumulative effects would be similar to those outlined for Alternative A, although reduced to the extent that the road could be removed from the riparian corridor. Retaining a potentially disturbing feature such as a road in an important wildlife habitat type like the riparian area of Salt Creek Canyon could reduce the refuge quality of the area for displaced wildlife. Therefore, the cumulative effects of this alternative, in combination with other past, present, and reasonably foreseeable future actions described in this paragraph, are expected to be negative, regional, long-term and minor.

Conclusion

The road and associated motorized and pedestrian traffic would still be present in the canyon bottom. The direct impacts of this alternative on wildlife in Salt Creek Canyon are, depending on the species, expected to be negative, site-specific, of intermediate to long-term duration, and of minor to major intensity. Indirect impacts, primarily due to habitat effects, would be negative, canyon-wide, of long term duration and minor to moderate intensity. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.2.3.4 Alternative D (Vehicles Prohibited All Year)

Direct and Indirect Effects

General

An indirect beneficial effect of this alternative would be to allow the creek and associated riparian zone to move toward a more natural profile and assume a proper functioning condition (see section 4.2.6.3). This is likely to result in a more extensive wetland and riparian zone in the canyon bottom, which would provide enhanced habitat values for most wildlife species. The indirect effect of this on wildlife populations and individuals would be positive, regional, of long-term duration, and of moderate intensity.

Birds

Closure of the road from Peekaboo to Angel Arch Canyon is unlikely to have a direct measurable impact on the bird populations in the area. However, the open road corridor has resulted in reduction of potential vegetation volume, which has been correlated with breeding bird densities (Mills et al. 1991). Schelz (2001) calculated that potential breeding bird density may be reduced by as many as 31 pairs due to the reduction in potential vegetation volume caused by the road. This volume would be largely restored over time if the road was closed and only a narrow foot trail remained.

Pedestrian movements have been found to be more disturbing to raptors and other birds than recreational activities such as motorized use. (Belanger and Bedard 1989, McGarigal et al. 1991, Holmes et al. 1993). Discontinuing vehicle access to the area should also reduce daytime pedestrian activity, restricting use to those who had the time and physical capability for long hikes. Some offsetting increase in overnight use may occur.

Because the road and associated motorized and pedestrian use would be eliminated, the direct and indirect effects of this alternative, on bird populations and individuals are expected to be positive, canyon-wide, of long-term duration, and of minor intensity.

Amphibians and Reptiles

Direct negative impacts of vehicles to amphibian larval and adult stages and reptiles are described under Alternative A, Section 4.2.2.3.1. These occur when individual adults are run over by vehicles, and amphibian larvae are crushed or washed out of pools by passing vehicles. These impacts would no longer occur under Alternative D. Direct and indirect impacts of this alternative would be positive, site-specific, of long-term duration, and of minor intensity.

Mammals

The presence of humans is known to influence the activities of most wild mammal species, and it is likely that human use of Salt Creek Canyon results in some level of disturbance and stress to the natural routine of mammals using the area (Elmore and Workman 1978). The higher the level of human use, the more pronounced the disturbance is likely to be. Direct effects of elimination of vehicle access under this alternative would likely include a decrease in the amount of daytime pedestrian use in the area, and therefore the frequency of direct and indirect contact with mammals. The indirect effects would result in fewer disturbances that could lead to harm, which in turn would be likely to 1). decrease risk of death for the affected animal as a

consequence of habituation to humans, or (2) decrease negative impacts on fecundity identified for Alternative A (increased energy expenditure and decreased access to important resources).

Because the road and associated motorized and pedestrian use would be eliminated, direct and indirect effects of this alternative on mammals would be positive, canyon-wide, of long-term duration, and of minor to moderate intensity.

Cumulative Effects

The implementation of the BMP in 1995 had the effect of regulating and limiting backcountry use in the park. This may have a positive impact by limiting frequency and intensity of disturbance from recreational activities, including placing a ceiling on any increase in overnight backpacking activity that might result from this alternative. It is possible that limits on backcountry use in the park could result in deflection of activities to public lands outside the park, where adverse wildlife impacts may then occur. The impacts of this alternative, in combination with other past, present, and reasonably foreseeable future actions, are expected to have both negative and positive minor cumulative effects.

Conclusion

Closure of the road under this alternative would eventually mitigate negative habitat effects, and would immediately remove direct disturbance factors related to motorized use and related pedestrian activity. Disturbance caused by the remaining trail and its use by hikers and backpackers would persist. Direct effects of this alternative on wildlife populations are expected to be positive, site specific to canyon-wide, long term and minor to moderate. The indirect impacts are expected to be positive, canyon-wide, of long-term duration, and of minor to moderate intensity. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.3 Soundscape

4.2.3.1 Introduction

Data was collected during a sound monitoring program conducted in the early 1990's in the Needles District and elsewhere in Canyonlands National Park. The ambient sound levels at all monitoring sites were extremely low, and consisted primarily of natural sounds such as wind and bird songs (Gdula and Gudorf 1998).

NPS Management Policies 2001, Section 4.9, directs the NPS to preserve and restore natural soundscapes where possible. Other laws, regulations and policies that may affect soundscapes are found in Chapter 6.

4.2.3.2 Methodology for Evaluating Impacts and Significance (Context, Duration, Intensity)

Existing information sources in the form of published research, policies and guidelines, and baseline monitoring data have been used to determine impacts and their significance for soundscape resources.

The following definitions apply to impact descriptions for the soundscape category:

Duration:

- Short-term: effect of each impact lasting a few seconds or less
- Intermediate: lasting from a few seconds to a few minutes
- Long-term: lasting from a few minutes to hours

Intensity:

- Negligible: positive or negative impact on the natural soundscape is zero or at the lowest levels of detection
- Minor: impact on the natural soundscape is slight, but detectable
- Moderate: impact on the natural soundscape is readily apparent
- Major: impact on the natural soundscape is severely adverse (negative) or exceptionally beneficial (positive)

4.2.3.3 Alternative Comparison

4.2.3.3.1 Alternative A- No Action (Vehicle Access All Year by Permit System)

Direct and Indirect Effects

By permitting limited vehicle use in the plan area, it is recognized that some level of human-caused sound would result, as would typically be the case in other backcountry road situations. Within the framework of NPS management policies, this level of intrusion on the natural soundscape would be considered acceptable given the decision to allow vehicle use. The requirement that all vehicles used in the backcountry road system in Canyonlands National Park be "street legal" ensures that engine noise would be muffled to the extent specified by state regulations, thereby preventing extreme noise levels. This level of human-caused sound impinging upon the natural soundscape may still be disturbing to hikers expecting a wilderness experience. This alternative would likely result in negative site-specific direct impacts of moderate intensity and intermediate duration.

Cumulative Effects

In the backcountry of Canyonlands, the only significant intrusion on natural soundscape other than four wheel drive vehicles and human voices comes from aircraft overflights. These are primarily of two types: high altitude commercial or military overflights, and low-level sightseeing flights. These overflights occasionally cause complaints from visitors, and can contribute to the

cumulative impacts on the natural soundscape. The increase in visitation to the frontcountry and backcountry of the park since its creation has no doubt resulted in localized deterioration of the natural soundscape from motorized traffic and general human activity. The 1995 BMP placed limits on the amount of overnight use in the backcountry, but did not address day use in most areas.

The cumulative effects of this alternative, taking into consideration the impacts of other past, present, and reasonably foreseeable future actions, are expected to be negative, park-wide, of intermediate duration and moderate intensity.

Conclusion

Direct impacts of this alternative on the natural soundscape of Salt Creek Canyon would be negative, site-specific, intermediate term, and moderate. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.3.3.2 Alternative B (Vehicle Access Part Year by Permit System)

Direct and Indirect Effects

Impacts would be similar to those caused by Alternative D, except for the time period designated as open to vehicle use, when impacts would be similar to those described for Alternative A.

Cumulative Effects

The cumulative impacts of this alternative would be similar to those described for Alternative D, except for the period when the road was open.

Conclusion

Direct impacts of this alternative on the natural soundscape of Salt Creek Canyon would be negative, site-specific, intermediate term, and moderate. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.3.3.3 Alternative C (Road Realignment)

Direct and Indirect Effects

Because a road and motorized use would remain in the canyon, impacts would be similar to those caused by Alternative A.

Cumulative Effects

The cumulative impacts of this alternative would be similar to those described for Alternative A.

Conclusion

Direct impacts of this alternative on the natural soundscape of Salt Creek Canyon would be negative, site-specific, intermediate term, and moderate. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.3.3.4 Alternative D (Vehicles Prohibited All Year)

Direct and Indirect Effects

This alternative would eliminate noise intrusions from four wheel drive vehicles on the natural soundscape of Salt Creek Canyon. Sounds in the area of the closed road would generally be limited to natural (non-human) sounds, sounds from overflying aircraft, and sounds made by hikers. While intrusions would remain, the net effect would an improvement in the natural soundscape.

Cumulative Effects

Although this alternative would eliminate noise from motorized vehicles in Salt Creek, many of the cumulative effect factors would remain, and would be similar to those described for Alternative A. In the backcountry of Canyonlands, the only significant intrusion on natural soundscape other than four wheel drive vehicles and human voices comes from aircraft overflights. These are primarily of two types: high altitude commercial or military overflights, and low-level sightseeing flights. These overflights occasionally cause complaints from visitors, and can contribute to the cumulative impacts on the natural soundscape. Although the 1995 BMP placed limits on the amount of overnight use in the backcountry, it did not address day use in most areas. The increase in visitation to the frontcountry and backcountry of the park since its creation has no doubt resulted in localized deterioration of the natural soundscape from motorized traffic and general human activity, and made it more diffcult to experience a natural soundscape. Therefore, the impacts of this alternative, in combination with other past, present, and reasonably foreseeable future actions, are expected to have positive long term cumulative effects of moderate intensity.

Conclusion

Direct impacts of this alternative on the natural soundscape of Salt Creek Canyon would be positive, site-specific, long-term, and moderate. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment of the park's resources or values.

4.2.4 Recreational Experience

4.2.4.1 Introduction

Salt Creek Canyon provides a unique recreational experience, whether accessed on foot or by vehicle. It supports one of the most important riparian ecosystems in the park. It is also the heart of the Salt Creek Archeological District, the area with the highest recorded density of archeological sites in the park. A tributary canyon contains the spectacular Angel Arch, a well-known geologic formation that for many years has been a destination point for park backcountry visitors.

NPS *Management Policies 2001*, Section 8.2 addresses recreational use of parks. Other laws, regulations and policies that may affect recreation and recreational impacts are found in Chapter 6.

4.2.4.2 Methodology for Evaluating Impacts and Significance (Context, Duration, Intensity)

Existing information sources in the form of published research, policies and guidelines, baseline monitoring data, and public scoping comments have been used to determine impacts and their significance for elements of the public recreational experience.

The following definitions apply to impact descriptions for the recreational experience category:

Duration:
- Short-term: effect of each impact lasting a few minutes to a few hours
- Intermediate: lasting from a few hours to a few days
- Long-term: lasting from a few days to indefinitely

Intensity:
- Negligible: the impact is zero or at the lowest levels of detection
- Minor: the impact is slight, but detectable
- Moderate: the impact is readily apparent
- Major: the impact is severely adverse (negative) or exceptionally beneficial (positive)

References to the availability of the opportunity or experience are defined as follows *(with examples)*:
- Unique: Only available at a single location *(visiting Delicate Arch or some one-of-a-kind feature)*
- Uncommon: Available in a small number of locations, or in multiple locations within a single area *(Whitewater rafting on the Colorado River)*
- Common: Available in many regions, areas or locations. *(Camping)*

4.2.4.3 Alternative Comparison

4.2.4.3.1 Alternative A – No Action (Vehicle Access All Year by Permit System)

Direct and Indirect Effects

Accessibility

This alternative would provide relatively easy access to the unique Angel Arch and the other resources of Salt Creek Canyon to anyone acquiring a permit to use a four-wheel drive vehicle. The BMP permit system would continue to limit the daily number of day-use vehicles in the area, so during periods of high demand, advanced planning and flexibility in timing would be necessary. Impacts of this alternative on accessibility to the unique combination of resources found in Salt Creek Canyon would be positive, of intermediate duration and moderate intensity.

Hiking/Backpacking

While vehicle access to trailheads in the park facilitates most hiking trips, the extent to which hikers rely on four wheel drive vehicles to augment their trip varies greatly. In Salt Creek Canyon, some hikers drive as far as they are permitted, then begin their day hike or overnight trip from that point. Others park their vehicles in the developed Squaw Flat area and negotiate Salt Creek Canyon entirely on foot. Under Alternative A, the option to travel by vehicle to the vicinity of Angel Arch and access much of upper Salt Creek Canyon in a single day's hiking would remain available. Hikers electing to hike in from Squaw Flat, Peekaboo Camp or some interim point would encounter vehicles traveling or parking in the canyon at various intervals. The extent to which this would be viewed negatively would vary with the individual. The opportunity for solitude would be reduced in those areas of canyon accessible to four-wheel drive vehicles. Hikers retain the option to experience the resources of Salt Creek Canyon under all alternatives. A decision not to enter the canyon because of the presence of motorized vehicles is a matter of preference. Impacts of this alternative on hiking/backpacking through the unique combination of resources found in Salt Creek Canyon would be mostly negative, of short to intermediate duration, and minor.

Cumulative Effects

The implementation of the BMP in 1995 had the effect of regulating and limiting backcountry use in the park. This had a park-wide impact on hiking/backpacking activities and accessibility. Opportunities in the region outside the park to hike long distances on trails not also used by mountain bikes or motorized vehicles are uncommon, as are opportunities for motorized access to the combination of resources found in Salt Creek Canyon.

The impacts of this alternative, in combination with other past, present, and reasonably foreseeable future actions, are expected to have minor positive cumulative effects on accessibility, and minor negative cumulative effects on accessibility.

Conclusion

Both motorized access and hiking/backpacking remain options for exploring Salt Creek Canyon under Alternative A, although the two activities produce interrelated impacts. The direct impacts of this alternative are expected to be positive, of intermediate duration, and of moderate intensity

for accessibility, and negative, of short to intermediate duration and of minor intensity for hikers.

4.2.4.3.2 Alternative B (Vehicle Access Part Year by Permit System)

Direct and Indirect Effects

Accessibility

Positive impacts on accessibility would be similar to those in Alternative A, but would be limited to the season in which the road would be open to vehicle travel. Permits to drive in Salt Creek Canyon may be harder to obtain at that time due to the limited period of availability. Otherwise impacts on accessibility would generally be negative in comparison with Alternative A.

Hiking/Backpacking

Negative impacts on hikers would be similar to those described in Alternative A, although limited to a much shorter timeframe. The canyon upstream from Peekaboo Camp would be free of vehicles for the remainder of the year, thus increasing the opportunity for solitude and a wilderness experience for hikers.

Cumulative Effects

The impacts of this alternative, in combination with other past, present, and reasonably foreseeable future actions, are expected to be similar to those cumulative effects described for Alternative A during the open road period, and as described for Alternative D when the road is closed.

Conclusion

This alternative would provide both motorized access and the opportunity for vehicle-free hiking, depending on the time of year. The direct impacts of this alternative are expected to be both positive and negative, of intermediate duration, and of moderate intensity for accessibility, and both positive and negative, of intermediate duration and of minor intensity for hikers.

4.2.4.3.3 Alternative C (Road Realignment)

Direct and Indirect Effects

Accessibility

The realigned road would remain open under the scenario described in Alternative A. Impacts affecting accessibility would be similar to those in Alternative A.

Hiking/Backpacking

The realigned road would remain open under the scenario described in Alternative A. Impacts affecting hikers would be similar to those in Alternative A.

Cumulative Effects

The impacts of this alternative, in combination with other past, present, and reasonably foreseeable future actions, are expected to be similar to those cumulative effects described for Alternative A.

Conclusion

The rerouted road would remain open and provide access similar to the scenario described in Alternative A. The direct impacts of this alternative are expected to be positive, of intermediate duration, and of moderate intensity for accessibility, and negative, of intermediate duration and of minor intensity for hikers.

4.2.4.3.4 Alternative D (Vehicles Prohibited All Year)

Direct and Indirect Effects

Accessibility

Elimination of access by vehicle would leave Angel Arch accessible only to those willing and able to make the 16 mile round trip hike or horseback ride from Peekaboo. Other sights in the canyon that could be viewed from in or near a vehicle would likewise be available only to hikers or from horseback. The opportunity to view Angel Arch is unique, as is the opportunity to experience the mix of other resources found in Salt Creek Canyon. Rather than being a matter of preference, individuals unable to walk or ride horseback have few other alternatives for accessing the area. Direct impacts on those requiring vehicle access to view it would therefore be negative, long-term, and moderate to major.

Hiking/Backpacking

Hikers wishing to view Angel Arch would be required to walk the full distance from Peekaboo Camp (or further, if they had no access to a four-wheel drive vehicle), which may be viewed by some as negative. Those desiring solitude and a wilderness experience would encounter no vehicles, and probably fewer daytime pedestrians than under alternative A. Some increase in overnight backpacking activity may occur. Impacts on hiking activity in Salt Creek Canyon would be mostly positive, long-term, and moderate.

Cumulative Effects

The ability to view a significant arch formation from in or near a vehicle is available in the region, but uncommon. The region provides abundant opportunities to access other natural and cultural resources by vehicle. The opportunity to hike long distances on a trail not open to four-wheel drive vehicles, and where a water source is available, is uncommon in the region. Some increase in overnight backpacking activity may occur as a reaction to the opportunity for more of a wilderness experience in the absence of vehicles. The BMP would provide a ceiling on the number of backpackers using the area at a given time.

The impacts of this alternative, in combination with other past, present, and reasonably foreseeable future actions, are expected to have minor negative cumulative effects on accessibility, and minor positive cumulative effects on hiking/backpacking.

Conclusion

The impacts of this alternative are expected to be negative, of long-term duration, and of moderate to major intensity for accessibility; mostly positive, site-specific, of long-term duration and of moderate intensity for hikers.

4.2.5 Archeological Resources

4.2.5.1 Methodology for Evaluating Impacts and Significance (Context, Duration, Intensity)

Under Section 106 of the National Historic Preservation Act (NHPA) of 1966, only historic resources that are eligible for or are listed on the National Register of Historic Places, such as those sites found within the Salt Creek Archeological District, are analyzed for impacts. An impact, or effect, to a property occurs if a proposed action would alter in any way the characteristics that qualify it for inclusion on the register.

In this EA, impacts to the cultural resources that are potentially eligible for, or listed in, the National Register of Historic Places are described in terms of type, context, duration, and intensity, which is consistent with the regulations of the CEQ that implement the National Environmental Policy Act (NEPA). Archeological impact analyses here are intended, however, to comply with the requirements of both NEPA and Section 106 of the NHPA. In accordance with the Advisory Council on Historic Preservation's regulations implementing Section 106 (36 CFR Part 800, Protection of Historic Properties), impacts to archeological resources were identified and evaluated by: 1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that were either listed in or eligible to be listed in the National Register of Historic Places; (3) applying the criteria of adverse effect to affected cultural resources either listed in or eligible to be listed in the National Register; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register, in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (36 CFR 800.5 (a)(1)). The characteristics that qualify a property for inclusion in the National Register, and which are used to determine the property's historic significance, are listed in 36 CFR 60.4. The standard set forth under Section 106 is effect, not proximity or magnitude (36 CFR 800.5). (See Federal Register, Volume 65, No. 239, page 77707.)

CEQ regulations and the NPS Directors Order12 (USDI National Park Service 2001b) also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact, e.g., from the major level to the moderate or minor level. A reduction in the estimated intensity of an impact as a result of mitigation is acceptable under NEPA. Under Section 106, though an adverse effect may be

mitigated (by scientific excavation and data recovery, for example), the effect remains adverse.

For purposes of analyzing impacts to archeological or ethnographic resources, thresholds of change for the intensity of an impact are based upon the potential of the site(s) to yield information important in prehistory or history, as well as the probable historic context of the affected site(s):

- Negligible: The impact is at the lowest level of detection—barely measurable with no perceptible consequences to archeological or ethnographic resources.
- Minor: The impact affects an archeological site(s) with little or no potential to yield information important in prehistory or history. These archeological resources are generally ineligible to be listed in the National Register.
- Moderate: The impact affects an archeological site(s) with the potential to yield information important in prehistory or history. The historic context of the affected site(s) would be local or state.
- Major: The impact affects archeological site(s) with the potential to yield important information about human history or prehistory. The historical context of the affected site(s) would be national.

4.2.5.2 Alternative Comparison

4.2.5.2.1 Alternatives A and B (Vehicle Access All Year or Part Year, by Permit System)

Direct and Indirect Effects

There would be moderate direct and indirect effects on archeological resources under Alternative A and Alternative B. These alternatives involve continued ground disturbance caused by the weight and grinding of vehicle tires upon diagnostic cultural materials that have potential to yield information important in a state and regional context.

Archeologists from the NPS Intermountain Support Office in Santa Fe, New Mexico, and from the Southeast Utah Group (Brunnemann et al. 2001) determined that all six sites identified are eligible for nomination to the National Register under Criterion D (36 CFR 60.4 (d)). The sites: 1) are in good to fair condition and have potential for future scientific investigation; 2) are adversely impacted by the Salt Creek Road; and 3) because of their potential to yield archeological information, the sites are eligible for nomination to the National Register of Historic Places.

As noted in Section 3.2.5.1, the archeological "condition" of a site is derived from definitions set forth in the current NPS Resources Management Plan (RMP) for those archeological resources recorded in the NPS Archeological Sites Management Information System (ASMIS). The archeological site condition determinations made during the survey of Salt Creek Road in May 2001, and presented in this document, were recorded during the period when Salt Creek Road had been closed to vehicle access. Herein, site condition refers to the physical stability of the site and its potential for deterioration over time, at the time of inspection. Table 3 summarizes the information obtained for each site.

Table 3. Summary Site Information, Salt Creek Road archeological inventory (Brunnemann et al. 2001)

Site Number	Description	National Register Status	Condition	Research Potential	Impacts
42SA24 649	Lithic quarry, lithic scatter, rock shelters	Significant according to Criterion D	Good. Site is considered currently stable.	High	Salt Creek Road (damaged artifacts, increased erosion, disturbed deposits), natural erosion, visitation
42SA24 650	Lithic quarry, lithic scatter, rock shelters	Significant according to Criterion D	Good. Site is considered currently stable.	High	Salt Creek Road (damaged artifacts, increased erosion, disturbed deposits), natural erosion, visitation
42SA24 651	Lithic scatter, rock shelters	Significant according to Criterion D	Fair. The identified threats, left to continue without the appropriate corrective action, would result in the site being degraded to a poor condition.	Moderate	Salt Creek Road (damaged artifacts, increased erosion, disturbed deposits), natural erosion, visitation
42SA24 652	Historic fence, rock shelter	Significant according to Criterion D	Fair. The identified threats, left to continue without the appropriate corrective action, would result in the site being degraded to a poor condition.	Moderate	Salt Creek Road (increased erosion, disturbed deposits), visitation, past cattle activity
42SA24 653	Lithic scatter	Significant according to Criterion D	Fair. The identified threats, left to continue without the appropriate corrective action, would result in the site being degraded to a poor condition.	Moderate	Salt Creek Road (increased erosion, damaged artifacts, disturbed deposits)
42SA24 654	Lithic scatter	Significant according to Criterion D	Fair. The identified threats, left to continue without the appropriate corrective action, would result in the site being degraded to a poor condition.	Moderate	Salt Creek Road (increased erosion, damaged artifacts, disturbed deposits)

Alternative A and Alternative B would impact resources identified in the park's enabling legislation (archeological features), affect the park's National Register property (Salt Creek Archeological District), and affect resources that are eligible for the National Register of Historic Places. Alternatives A and B would both involve either continued or new ground disturbance. An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (36 CFR 800.5 (a)(1)). Alternatives A and B would allow vehicles to pass through six cultural properties determined to be eligible for nomination to the National Register of Historic Places (36 CFR 60.4 (d)), within Salt Creek Archeological District. This constitutes adverse effect. Artifacts in the roadbed display evidence of having been crushed between the bedrock and vehicle tires.

Cumulative Effects

Past vehicular access in Salt Creek Canyon has increased exposure of prehistoric lithic materials. Downcutting or excavation by vehicle tires into the sandy benches along Salt Creek has made road shoulder slopes steeper, thereby increasing the rapidity of erosion of sediments

and exposing buried archeological materials when precipitation produces runoff. As a result of accelerated runoff, these exposed archeological materials may have lost their depositional context, and are vulnerable to displacement, crushing, theft, and contamination. Such cumulative effects exclude these artifacts from providing diagnostic information about human history or prehistory. Past vehicle use has also facilitated human access to Salt Creek sites, with attendant deliberate or accidental adverse impacts in the form of site touring, vandalism, or theft. In a broader context, archeological resources throughout the region have been adversely impacted or destroyed by erosion, vandalism and theft. Therefore, the cumulative effects of this alternative, in combination with other past, present, and reasonably foreseeable future actions described in this paragraph, are expected to be negative, long-term and of minor to moderate intensity.

Conclusion

Adverse effect criteria are linked specifically to objective National Register criteria (36 CFR 60.4), which are used to determine characteristics that contribute to a property's historic significance. If those characteristics are adversely affected, then the historic significance is reduced (Federal Register, Volume 65, No. 239, page 77707). Alternatives A and B would affect those characteristics that contribute to the historic significance of six cultural properties determined to be eligible, in a local/regional or state context, for nomination to the National Register of Historic Places (36 CFR 60.4 (d)), within Salt Creek Archeological District.

For the purposes of this assessment, Alternative A and Alternative B would have moderate impacts to archeological cultural resources that are either eligible or listed on the National Register of Historic Places.

In these alternatives there would be moderate adverse impacts to a cultural resource or value according to the NHPA (36 CFR 800.5). The archeology of Salt Creek Archeological District is identified in the GMP for "preservation, protection, and interpretation of cultural resources and their settings." However, these impacts do not constitute impairment of park resources or values for the following reasons: (1) While conservation of archeology is necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park ("...to preserve an area in the State of Utah possessing superlative scenic, scientific, and archeological features..."), the preservation, protection, and interpretation of six archeological sites located in Salt Creek Road can be meaningfully accomplished via comprehensive scientific data recovery. (2) while the May 2001 archeological inventory of Salt Creek Road identified six cultural properties that have yielded, and may likely yield, information important in prehistory and history, this surface survey did not report cultural manifestations that are key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park.

4.2.5.2.2 Alternative C (Road Realignment)

Direct and Indirect Effects

Alternative C may impact resources identified in the park's enabling legislation (archeological features), and may affect resources that are eligible for the National Register of Historic Places. Alternative C may affect the park's National Register property (Salt Creek Archeological District). Alternative C would involve ground disturbance.

There may be direct and indirect effects on the Salt Creek Archeological District under Alternative C. This alternative involves ground disturbance upon a property listed on the National Register of

Historic Places.

Adverse effect criteria are linked specifically to objective National Register Criteria for Evaluation for eligibility to the National Register (36 CFR 60.4), which are used to determine characteristics that contribute to a property's historic significance. The standard set forth under section 106 is effect, not proximity or magnitude (36 CFR 800.5). (See Federal Register, Volume 65, No. 239, page 77707.) While it is possible that distance separating an undertaking from a particular (discrete) historic property may remove any effects, such a determination is not suitable for an Archeological District. Alternative C would align new road segments within the finite space of Salt Creek bottomland, within Salt Creek Archeological District.

In November 2001 NPS conducted an approximately three-mile long reconnaissance from the Peekaboo Campsite, south towards Angel Arch, within the canyon floor of Salt Creek. The purpose of the reconnaissance was to field check the feasibility of any realignment to Salt Creek Road. The realignment of approximately 1.85 miles of existing road to avoid riparian areas surrounding Salt Creek determined that this realignment strategy would pass adjacent to three prehistoric pictograph sites (42SA1506, 42SA1572, 42SA1692), and would directly impact three unrecorded archeological sites, including: a large multi-component site (prehistoric and historic habitation), a prehistoric lithic site, and a historic site. Although this constitutes adverse effect, a realignment strategy (regardless of riparian areas) might avoid cultural properties within the canyon floor of Salt Creek.

Cumulative Effects

An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (36 CFR 800.5 (a)(1)). Alternative C would construct new road within a National Register Property that may, depending on the engineering of any proposed realignment, alter the characteristics of Salt Creek Archeological District by affecting cultural properties that qualify for inclusion in the National Register. Past vehicle use has also facilitated human access to Salt Creek Archeological District, with attendant deliberate or accidental adverse impacts in the form of site touring, vandalism, and theft. In a broader context, archeological resources throughout the region have been adversely impacted or destroyed by erosion, vandalism and theft. Therefore, the cumulative effects of this alternative, in combination with other past, present, and reasonably foreseeable future actions described in this paragraph, are expected to be negative, long-term and of moderate intensity.

Conclusion

Avoidance of cultural properties, if possible, would eliminate adverse effects and result in a no effect determination for Section 106 purposes. Alternative C would construct new road within a National Register Property that may alter the characteristics of Salt Creek Archeological District and affect cultural properties that qualify for inclusion in the National Register. Adverse effect criteria are linked specifically to objective National Register criteria (36 CFR 60.4), which are used to determine characteristics that contribute to a property's historic significance. If those characteristics are adversely affected, then the historic significance is reduced (Federal Register, Volume 65, No. 239, page 77707). Alternative C may affect those characteristics that contribute to the historic significance of Salt Creek Archeological District, regardless of its impacts on specific individual sites.

For the purposes of this assessment, it is the likely that, if individual sites can be avoided, Alternative C may have no impacts to individual archeological resources that are either eligible or listed on the National Register of Historic Places. Alternative C may, however, have moderate negative impacts on the Salt Creek National Register Archeological District.

In this alternative there may be moderate adverse impacts to a cultural resource or value in a local/regional or state context, according to the NHPA (36 CFR 800.5). The archeology of Salt Creek Archeological District is identified in the GMP for "preservation, protection, and interpretation of cultural resources and their settings." However, these impacts may not constitute impairment of park resources or values for the following reasons: (1) Conservation of archeology is necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park ("...to preserve an area in the State of Utah possessing superlative scenic, scientific, and archeological features..."). Preservation, protection, and interpretation of six archeological sites located in Salt Creek Road can potentially be accomplished by relocating Salt Creek Road to avoid cultural properties. (2) Although the May 2001 archeological survey did not report cultural manifestations that are key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, the sites have yielded, and may likely yield, information important in prehistory and history, and avoidance will preserve this potential information.

4.2.5.2.3 Alternative D (Vehicles Prohibited All Year)

Direct and Indirect Effects

There would be negligible direct and indirect effects on archeological cultural resources under Alternative D. There would be no use of the Salt Creek road by vehicles, and no road realignment. There would be continued ground trampling by pedestrians along the remaining trail, but it is unlikely to involve appreciable degradation of any archeological cultural resources.

Alternative D would prohibit vehicles between Peekaboo Campsite and Angel Arch, eliminating adverse impacts as a result of increased soil erosion caused by vehicle traffic on Salt Creek road, and physical damage to archeological materials from pressure and grinding by vehicle traffic. This action would not alter the characteristics of Salt Creek Archeological District which qualify the property for inclusion in the National Register. This constitutes no effect.

Cumulative Effects

There would be no new ground disturbance under this alternative. There would be continued pedestrian ground trampling, but it would not involve degradation of any archeological cultural resources. Natural erosion and social trails do not appear to have physically damaged these archeological deposits in the past and therefore should not damage archeological deposits in the future. Accelerated erosion caused by precipitation runoff coursing through archeological deposits and into Salt Creek Road may continue to undercut the six archeological sites identified in the NPS archeological survey (May 2001). Past vehicle use has also facilitated human access to Salt Creek Archeological District, with attendant deliberate or accidental adverse impacts in the form of site touring, vandalism, and theft. In a broader context, archeological resources throughout the region have been adversely impacted or destroyed by erosion, vandalism and theft. The cumulative effects of this alternative, in combination with other past, present, and reasonably foreseeable future actions described in this paragraph, are expected to be neutral, long-term and of negligible intensity.

Conclusion

Altemative D would not adversely affect the characteristics that contribute to the historic significance of Salt Creek Archeological District or cultural properties that are eligible for the National Register of Historic Places. Mitigation of pedestrian impacts by rerouting the remaining foot trail would be possible under this altemative as part of a preservation plan.

In this alternative there are negligible impacts to cultural resources or value according to the NHPA (36 CFR 800.5). The archeology of Salt Creek Archeological District is identified in the GMP for "preservation, protection, and interpretation of cultural resources and their settings." Altemative D does not constitute impairment of park resources or values for the following reasons: (1) Conservation of archeology is necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park ("...to preserve an area in the State of Utah possessing superlative scenic, scientific, and archeological features..."). Protection of the six archeological sites thus far located in Salt Creek Road can be accomplished by reducing ground disturbance and including all six sites in the park's site-monitoring program. (2) Although the May 2001 archeological survey did not report any cultural manifestations that are key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, the sites have yielded, and may likely yield, information important in prehistory and history, and avoidance will preserve this potential information.

4.2.6 Riparian/Wetland Ecosystem

4.2.6.1 Methodology for Evaluating Impacts and Significance (Context, Duration, Intensity)

Impact forecasts from vehicle access alternatives to the Peekaboo-Angel Arch segment of Salt Creek were based on observed conditions in this canyon section, both with vehicle traffic (until summer 1998), and without vehicle traffic (summer 1998 to present). These conditions were compared to those in the Peekaboo to Cave Spring section, where vehicles are still permitted, and the section above the Angel Arch tumoff, where vehicles have not driven for at least 25 years.

Data from the park's monitoring program, independent scientific investigations, and input from scientists with particular subject matter, regional and/or local expertise were used. Relevant scientific and resource management literature was also considered. Elements included:

- The park regularly monitors various riparian parameters, including geomorphology, hydrology, water quality, vegetation, benthic macroinvertebrates, as well as repeat photographs.
- The interagency National Riparian Service Team assessed Salt Creek reaches on the ground and using aerial photographs from 1995 and the 1950s (Elmore et al. 2001), using the standardized "Proper Functioning Condition" methodology for riparian/wetland areas (Prichard et al. 1998, 1995), which incorporates geomorphic, hydrologic and vegetation characteristics.

- Utah state water quality standards were the basis for evaluation of chemical and physical water quality data.
- Affected riparian/wetland area was measured using on-ground measuring wheels and global positioning system (GPS) units, and remote sensing with aerial photographs and a geographic information system (GIS).
- Wolz and Shiozawa (1995) investigated aquatic macroinvertebrates in Salt Creek
- Mitchell and Woodward (1993) investigated vegetation, sedimentation, and aquatic organisms in Salt Creek.
- Scientists affiliated with universities, the U.S. Geological Survey, and consulting firms provided information.

The following definitions apply to impact descriptions for the riparian/wetland ecosystem category:

Duration:

- Short-term: effect of each impact lasting up to several months
- Intermediate: lasting from several months to a few years
- Long-term: lasting from several years to permanently

Intensity:

Riparian/Wetland Functioning Condition. This standardized evaluation procedure (Prichard et. al. 1998, 1995) has three possible ratings for riparian areas. See page 44 for complete definitions:
- Properly functioning condition (PFC).
- Functional—at risk. For areas in this category, trend is also classified, as upward (improving), downward (deteriorating), or not apparent (static).
- Nonfunctional.

Impact thresholds are based on functional condition ratings expected to result from contemplated alternatives:
- Negligible: maintains existing proper functioning condition
- Minor: maintains existing functional—at risk condition and trend
- Moderate: improves or degrades to functional—at risk condition; or maintains existing functional—at risk condition but changes trend (e.g. from upward to no trend or vice versa)
- Major: improves to PFC, regardless of prior condition; maintains, or degrades to, nonfunctional condition

Area (acres/square feet) of Riparian/Wetland Disturbance. Thresholds are based on Army Corps of Engineers thresholds for various nationwide permits for actions affecting waters of the U.S., including wetlands:
- Negligible: loss/effect to less than 1/3 acre of wetland
- Minor: loss/effect to 1/3 - 3 acres of wetland
- Moderate: loss/effect to 3 - 10 acres of wetland
- Major: loss/effect to over 10 acres of wetland

Water Quality. Thresholds are based on Utah state water quality standards, pollution indicators, and criteria for assessing degree of support of designated uses (full, partial, or non-use support; UT DEQ 2002a, 2002b), for Salt Creek designated uses (classes 1C, domestic use with prior treatment, 2B, secondary contact recreation, 3B, warm water aquatic life, and 4, agriculture),

when effects can reasonably be associated with contemplated management alternatives (e.g. prominent differences in creek sections with and without vehicle travel):

- Negligible: Changes, but not exceedences, in any pollution indicator level, without violating water quality standards
- Minor: Changes in frequency of exceedences of any pollution indicator, but no violations of water quality standards
- Moderate: Changes in frequency or magnitude of violations of water quality standards, but not sufficient to cause change in degree of support of designated uses (full, partial, or non-use support)
- Major: Change in frequency or magnitude of violations of water quality standards, sufficient to cause change in degree of support of designated uses

4.2.6.2 Alternative Comparison

4.2.6.2.1 Alternative A – No Action (Vehicle Access All Year by Permit System)

Direct and Indirect Effects

Riparian/Wetland Functioning Condition

The climate, watershed conditions and stream types in Salt Creek result in a certain amount of natural lateral and vertical instability. C4 and C5 stream types, as in Salt Creek, are susceptible to shifts in both lateral and vertical position caused by changes in the flow and sediment regimes of the contributing watershed (Rosgen 1998). Southwest desert streams with sand-dominated beds may have braided channels, bank erosion, sediment deposition, and shifts of bed location, reflecting high sediment loads (Prichard et al. 1998). Localized scour and fill in some sand channels may approach 10 feet or more during the passage of a single flood event, with virtually no long-term change in streambed elevation (Prichard et al.1998). Higher bank erosion rates are expected in sand-dominated channels than in channels where silts and clays provide cohesiveness (Prichard et al. 1998). However, a channel that relocates itself with every flood event would be considered excessively variable (Prichard et al. 1998). The Properly Functioning Condition approach takes into account the potential for a given site, evaluating existing stream conditions and processes against the expected ranges of variability for the particular stream types and watershed settings.

When people first started driving up Salt Creek in the 1950s it was in a wide, sandy, unstable channel, due to the previous downcutting episode (which probably resulted from climate changes and/or livestock grazing), and historic reports suggest that "almost every" storm moved the channel and erased vehicle tracks. Since then, grazing has ceased, exotic tamarisk has become extensive below Peekaboo, climate may have become more conducive to vegetative colonization and channel aggradation, and bank-stabilizing vegetation has increased, except in the road. This has occurred during the period that vehicles were travelling along and in the creek bed (the average rate was probably ten vehicles or less per day, with occasional peaks of 50 vehicles or more prior to 1995), though most of the improvement probably occurred after the cessation of grazing in the mid-1970s. The magnitude of the effect of the downcutting event and grazing appears to have been greater than that of vehicle travel. The stream has improved, from nonfunctional condition in the 1950s to "functional-at risk" condition at present in sections travelled by vehicles.

Several differences are evident between Salt Creek reaches with and without vehicle traffic:

- Channel shape and width to depth ratio: The channel has a roadbed shape where occupied by the road, and a typical Rosgen (1996) C channel shape elsewhere. The channel tends to be wider where road and channel coincide (Elmore et al 2001, Inglis 2001). Width to depth ratio ranges from 8.4 to 44.9 at cross-sections where the road is in the streambed, with an average of 19.6; it ranges from 4.2 to 10.8, with an average of 6.8, where the road is outside the channel (Schelz 2001).
- Stream channel length, sinuosity, and lateral channel movement: Road sections that shortcut across stream meanders or parallel the channel have captured the streamflow in some places, shortening and straightening the channel and controlling lateral channel movement, particularly in the reach below Horse Canyon (Elmore et al. 2001, Schelz 2001, Webb 2001, Springer 2001, Carothers 2001, Inglis 2001).
- Energy-dissipating characteristics from connection between channel, floodplain and/or overflow channels: Overflow channels are present, but are not always reached by flood flows because the road blocks access or diverts flow (Elmore et al. 2001).
- Vegetation: Percent bank cover by flood-resistant riparian vegetation along Salt Creek is estimated at less than 70 percent along the roaded channel and over 90 percent along the roadless channel (Elmore et al. 2001). The roadless canyon section is higher than the roaded section in total plant cover, plant structural complexity, total tree coverage, and frequency and/or ground coverage of several riparian plant species (Mitchell and Woodward 1992).

These characteristics all influence the stability and functionality of the stream channel and riparian/wetland area, and the vulnerability to degradation from regular flood events. Changes in stream morphology (e.g. straighter channel) and vegetation associated with the road concentrate flood flows, increasing water velocity and erosive force. This reduces water retention in the alluvial aquifer, lowers the water table and shortens the duration of surface flow (Elmore et al. 2001, Prichard et al 1998). Pools located where the road crosses or enters/exits the channel may be susceptible to accelerated scouring and enlargement from high flows (Springer 2001, Inglis 2001).

Vegetation is generally more extensive and continuous in the roadless section of Salt Creek than the roaded section. Plant species characteristic of a higher-moisture environment, uncommon in the desert surroundings, are more frequent and continuous in the roadless canyon section than in the roaded canyon section (Mitchell and Woodward 1992). This may be influenced in part by higher or longer-duration moisture availability in the roadless section, or other factors unrelated to the presence of vehicles. However, reduced vegetation is evident even in wetter sections where the road is in the channel, in repeat photographs comparing periods with and without vehicle traffic (see appendix 2).

The wetter channel sections, where riparian vegetation is or can be established, are the most susceptible to vehicle impacts (Inglis 2001). Drier sections of the creek have little or no riparian vegetation to be affected, and have been slower to recolonize with the cessation of vehicle travel. These reaches also may have a gravel or cobble substrate somewhat resistant to vehicle erosion and compaction (Inglis 2001). These sections, however, may have the potential to accumulate fine sediment, which improves water storage and streamflow duration and supports the establishment of plants, if not prevented by destabilizing activities. Vehicle travel inhibits this process.

Tamarisk may have a competitive advantage over native riparian species in (former) floodplains

above incised channels, where regular floods no longer reach the floodplain, such as may be caused by vehicle travel in and along the Salt Creek channel (Elmore et al. 2001). Tamarisk has a deeper taproot and more ability to tolerate dessication than native riparian species like willows, rushes and sedges (Horton 1977), and can reach deeper water tables. Conversely, regular flooding may favor riparian natives. While tamarisk seedlings can establish quickly and prolifically, they have less ability to stabilize soils than natives (Winward 2000), and are susceptible to being washed away by floods (Pistrang 1987, Irvine and West 1979, Horton 1977).

Other, minor impacts of vehicle traffic on the riparian/wetland system include soil compaction, direct erosion of soil by spinning tires, and increases in streamflow sediment (Webb 2001).

There would also be slight impacts from hiking use on soil, channel morphology, and vegetation, but these would generally be confined to the road and existing trails, and overshadowed by vehicle impacts. Hikers generally follow the existing road/stream channel, except when or where it has surface flow. Discontinuous sections of foot trail, established adjacent to wetter sections of the road/channel, would continue to be used by hikers as well as vehicle travellers scouting around flooded road sections.

According to the Proper Functioning Condition evaluation procedure (Prichard et al. 1998, 1995), the creek section below Horse Canyon (which is still travelled by vehicles) is in functional–at risk condition with no apparent trend or a static trend. Horse Canyon to Angel Arch turnoff is in functional—at risk condition with an upward trend. The difference in trend was attributed to vehicle impacts (Elmore et al. 2001). While the latter section includes about one mile (Horse Canyon to Peekaboo) of the 8.6-mile length which continues to be travelled by vehicles, the improvement in this reach is occurring in the section where vehicles are not currently permitted, and setback of this improvement could be seen after an unauthorized vehicle trip involving only four vehicle passes. Though the riparian area has improved since the 1950s to a functional, but at risk, condition, vehicle travel appears to be holding recovery in check, keeping it from reaching a fully functional condition. In contrast, the reach without vehicle traffic for the last 25 years or more (from a half-mile above Angel Arch turnoff to the Upper Jump) has recovered to properly functioning condition since the 1950s.

Based on the condition of the section currently travelled by vehicles, the functional–at risk condition would be expected to continue on the Peekaboo - Angel Arch section, but without an upward trend, under this alternative. This would be a minor to moderate direct impact; improvement of this condition would be unlikely as long as vehicle travel continues.

While this marginally functional condition may continue with vehicle traffic, at least in the short term, there would be a continuing risk of indirect, major impact as a result of a flood event of a magnitude that recurs regularly (i.e. five to twenty year recurrence intervals, which have 20 percent and five percent probability, respectively, of occurring in any given year; Elmore et al. 2001, Prichard et al. 1998). Such floods could degrade the riparian system to a nonfunctional condition. In contrast, a channel in properly functioning condition would be able to withstand events of this magnitude without degradation.

An impact level of at least minor to moderate would continue in the long term. However, a major indirect impact would be possible at any time; this major indirect impact would persist in the long term, since recovery time increases considerably when riparian areas become nonfunctional (Prichard et al. 1998).

A flood in August 2001, resulting from an estimated five to ten year precipitation event, caused

considerable erosion of the travelway below Peekaboo. A hole estimated at twenty feet wide by five feet deep was scoured out in one location, and another several hundred feet of road were rendered impassable and required relocation. Erosion of this magnitude, and possibly greater, could be expected to recur fairly regularly with the channel in functional--at risk condition. A channel in properly functioning condition would be expected to withstand floods of this magnitude or possibly larger.

A headcut has developed where the jeep road is in an overflow channel near the upstream end of the road, about a quarter-mile downstream from the Angel Arch turnoff. This indicates an area with an accelerated rate of vertical channel erosion, and may be the first Salt Creek section to degrade if additional destabilizing force is applied. If not stabilized by vegetation, the channel is susceptible to downcutting from this point, vertically and upstream, to the next geological or structural control, such as bedrock. Upstream progress of this headcut, eroding the channel and banks, would potentially remove the riparian area for as much as 100 yards upstream (Elmore et al. 2001).

Area of Riparian/Wetland Disturbance

The area of direct riparian disturbance would include the area of the existing jeep road, plus occasional, minor new disturbance from drivers pioneering detours around areas that have become impassable from streamflow. Resulting abandoned road sections in the riparian area would likely be reclaimed by vegetation and channel changes in the intermediate to long term. Area of direct riparian disturbance between Peekaboo and the Angel Arch turnoff would be expected to increase by less than one acre, remaining at approximately 6 acres (4.3 linear miles). This would be a direct impact of minor intensity.

The riparian area would remain at risk of major indirect effects from road-aggravated flooding, as discussed under Functioning Condition above. Flooding of a magnitude that recurs regularly could substantially enlarge the impacted riparian area.

The minor level of impact would continue until expanded by a major indirect impact from flooding. Such a major indirect impact would be possible at any time, and would persist long-term.

Water Quality

A few violations of water quality standards, or exceedences of pollution indicators, occurred at sample sites both with and without vehicle use. The frequency of exceedences for total suspended solids (TSS) and phosphorus was 15 to 25 percent higher at monitoring sites with vehicle travel (Crescent Arch before June 1998 and Peekaboo) than at sites without vehicle travel (Crescent Arch after June 1998 and Bates Wilson campsite) (Schelz 2001; appendix 1). The mean for all Peekaboo phosphorus samples was 0.09 milligrams per liter, exceeding the criterion of 0.06 milligrams per liter that indicates the need for further study (Utah DEQ 2002a, 2002b). Differences in turbidity of 40 to 350 standard units between the Peekaboo and Bates Wilson sites appeared to violate the standard (an increase of 10 units) on several occasions. Levels for these three parameters were two to five times higher at the Peekaboo sampling site than at non-vehicle sites on several occasions (approximately 20 percent of samples). There appears to be an association between elevated levels for turbidity, TSS, and phosphorus, and vehicle travel in the stream. These parameters are not among the primary criteria used for evaluating the level of support for designated uses, however (Utah DEQ 2002a), so these levels would not be considered to reduce the creek's support of its designated uses at the Peekaboo site (or the others).

Previous sedimentation investigations (Mitchell and Woodward 1993) found that sand volume captured in sediment traps located below vehicle crossings was approximately 1.6 times higher than above crossings and in the non-vehicle reach (appendix 1).

Normal levels for turbidity, suspended solids, and possibly phosphorus would be expected to be elevated in a sparsely-vegetated watershed subject to intense rainstorms causing overland runoff and erosion. While Salt Creek is a naturally turbid stream for parts of the year, monitoring results also indicate that this is not a constant phenomenon. Natural turbidity is expected with higher stream flow and/or storm runoff, but at lower flows the stream clears up and can meet state criteria for sediment-related parameters. (Water quality testing is conducted at least two to three days after precipitation to minimize storm effects on results.) Vehicle traffic in the stream during otherwise lower-sediment periods would be expected to extend the duration of elevated sediment load, and to have a stronger effect on water quality, in the stream sections that are affected, during these periods than during higher (more turbid) flows. During these periods, however, the extent of the channel/road that has surface water to be impacted may be less than during high-water periods.

Most, and the largest, water quality violations and exceedences were from samples in the month of September, which is a fairly high recreational use period in Canyonlands. September does not have snowmelt to increase flows, but is one of the wetter months in Canyonlands and may have rainstorms which generate runoff.

Dissolved oxygen had higher frequencies of violations at the non-vehicle sites: 54 percent for Bates Wilson campsite and 67 percent for Crescent Arch after June 1998, vs. 23 percent for Peekaboo and 25 percent for Crescent Arch before June 1998. Dissolved oxygen is improved (increased) by turbulent mixing, so vehicles driving through the water probably enhance this constituent. However, the frequency of violations for both types of sites (vehicle and non-vehicle) are at the level of "non-use-support" for designated uses under the Utah state criteria (UT DEQ 2002a, 2002b), thus continued vehicle use may not result in meeting the criterion for full use support. (Non-use-support means that a water body is not supporting its designated uses, generally because of too many violations of water quality standards; full use support means that a water body has few or no violations of water quality standards and is supporting its designated uses.)

Vehicles also have the possibility of leaking petroleum products and/or antifreeze into the creek. Several incidents of vehicle fluid discharges into the creek have have been observed or reported to the NPS in the past; unobserved or unreported incidents may also have occurred. Many of these fluids (such as gasoline and antifreeze) are highly toxic for short periods after entering the water, but dissipate rather quickly. Others, such as crankcase oil and other heavier lubricants, are less toxic but persist longer in the environment. The park does not currently test for automobile-related contaminants, so does not have a systematic measure of the frequency or magnitude of this impact.

Vehicle travel in the creek, and resulting sedimention and turbidity, may affect macroinvertebrate diversity and abundance (Carothers 2001). Park monitoring results since 1997 suggest that species richness, or the number of species present, is higher in the pools without vehicle travel than in the pools where vehicle travel is still permited (Schelz 2001). Wolz and Shiozawa (1995) found higher numbers of species in the clear-water portion (10 species) than in the turbid-water portion (1 species) of a Salt Creek pool. Mitchell and Woodward (1993) found statistically significant differences between pools with and without vehicle travel for a few aquatic species, but data on other species did not indicate significant differences. Data on Salt Creek aquatic

organisms is in appendix 1.

Adverse impacts associated with vehicle travel include possible exceedences or violations from increased sediment-related constituents (total suspended solids, turbidity, phosphorus), potential vehicle fluid discharges, and possible impacts to aquatic macroinvertebrates. Beneficial effects associated with vehicle travel are limited to possible increases in dissolved oxygen, though comparison between vehicle and non-vehicle sample sites to date has not indicated increases sufficient to improve the level of support of designated uses above non-use support.
The direct effects (violations and exceedences) associated with vehicle travel do not change the creek's support of its designated uses, according the the Utah state criteria, compared to the stream section without vehicles (though the phosphorus levels do indicate the need for further study), so these effects are considered to be moderate and adverse. Duration of the direct effect coincides with the continuing presence of vehicles, which would be long-term under this alternative. Should the riparian area be indirectly degraded to nonfunctional condition, this would likely harm macroinvertebrate populations and increase the frequency of violations of water quality standards, preventing the creek from supporting its designated uses. This would be a major adverse impact; duration would be long term, since recovery time increases considerably when riparian areas become nonfunctional (Prichard et al. 1998).

More detailed water quality information can be found in appendix 1.

Cumulative Effects

Cumulative impacts include those of various past, present and reasonably foreseeable future actions, both within the immediate project impact zone and outside the project impact zone but within the Salt Creek watershed, combined with impacts from this alternative ("project-specific impacts"). These include both adverse and beneficial effects.

Livestock grazed the Salt Creek basin within Canyonlands National Park from around 1900 until the mid-1970s, and likely affected vegetation and geomorphology and influenced the arroyo downcutting episode that occurred before 1940. Since about that time non-native tamarisk (*Tamarix sp.*) has invaded riparian areas throughout the region, including Salt Creek. Non-native cheatgrass (*Bromus tectorum*) has also invaded throughout the region. Past grazing may have played a role in these invasions. Since the 1950s there has been considerable increase of vegetation in the Salt Creek canyon bottom, both tamarisk and native species. The impacts from grazing in the park have diminished since it ceased, but some effects probably persist. The presence, sometimes dominant, of exotic species currently perpetuates the altered status of the riparian ecosystem.

The only current activity in the Salt Creek basin within Canyonlands National Park is recreation, supported by hiking, driving and camping. The only developed facilities existing or contemplated within the basin in the park are various administrative buildings and facilities, located downstream from the geographic scope of this EA, which probably occupy less than five percent of the watershed. Reasonably foreseeable future activities within the park include continuing recreation, administrative activities, maintenance of the facilities, and exotic plant removal. The project-specific impact (the Peekaboo to Angel Arch section) of this alternative affects about 8.6 miles of the overall 40.2 miles of Salt Creek length. Another 3.6 miles of the creek has a four-wheel-drive road within or alongside the stream channel. The remaining 22.3 miles of Salt Creek length within the park does not have a road in the channel, and could generally be considered to have increased vegetation since the cessation of livestock grazing, though a considerable portion is exotic species.

The approximately 5.5 miles of Salt Creek upstream from Canyonlands National Park is public land under multiple-use management. A formal assessment of riparian functioning condition has not been conducted on this stream reach, but the Bureau of Land Management estimates that it is in properly functioning condition (Curtis 2002). Past, present and reasonably foreseeable activities in this upper basin include:

- backcountry recreation, including four-wheel-driving, off-road vehicles, hiking, hunting, and horseback riding
- gravel or unsurfaced roads
- livestock trailing and grazing
- vegetation removal and replacement (chaining, timber cutting, reseeding etc.)
- prescribed and natural fire

Functioning condition ratings, mileages, and percentages of total length, for the portions of Salt Creek outside the Peekaboo to Angel Arch section (Elmore et al. 2001) are as follows (Figure 9):

- Properly functioning condition: 22.2 miles / 55 percent
- Functional—at risk condition: 9.4 miles / 23 percent

The project-specific impact of alternative A would be that the 8.6 miles from Peekaboo to Angel Arch junction (21 percent of total length) would likely remain in functional–at risk condition long-term, unless degraded to nonfunctional condition first by a flood. Combined with the project-specific impact of alternative A, the cumulative impact would be that 18 miles, or 45 percent of the total creek length, would be in functional—at risk condition, with 22.2 miles, or 55 percent of total length, in proper functioning condition. This is considered a moderate cumulative impact, with the potential for a major cumulative impact if functional—at risk reaches are degraded by flooding.

Conclusion

This alternative would prevent the riparian area between Peekaboo and the Angel Arch tumoff from reaching properly functioning condition. Geomorphic and vegetation characteristics where vehicles travel the streambed and riparian area would be inadequate to effectively dissipate flood energy and resist erosive force. While the riparian area would likely remain in functional—at risk condition for at least a short time, in this condition it would be vulnerable at any time to major degradation, rendering the riparian area nonfunctional, from a flood of a magnitude that recurs regularly (five to twenty year recurrence interval). A riparian area in properly functioning condition would withstand such a flood. While the direct impact of vehicle traffic would be minor to moderate, on functioning condition, amount of riparian area disturbed, and water quality, the indirect impact, from a fairly commonplace flood, would be major on these three characteristics. Such a major impact would persist long term, since recovery is greatly impeded when riparian areas become nonfunctional. Cumulatively, approximately 45 percent of the total Salt Creek stream length would continue in this at—risk condition long term, unless or until major indirect adverse impact from flooding occurs. The impact of alternative A on the riparian/wetland ecosystem would be comparable to that of alternative C, and higher than that of alternatives B and D.

Though this alternative would cause a lower level of direct impact than unlimited vehicle use, the likelihood of a major indirect impact from flooding would continue. Additional mitigation measures such as clearly delineating the road would not remove vehicle traffic from the streambed and riparian area. Consequently, this alternative would not fully mitigate this impact.

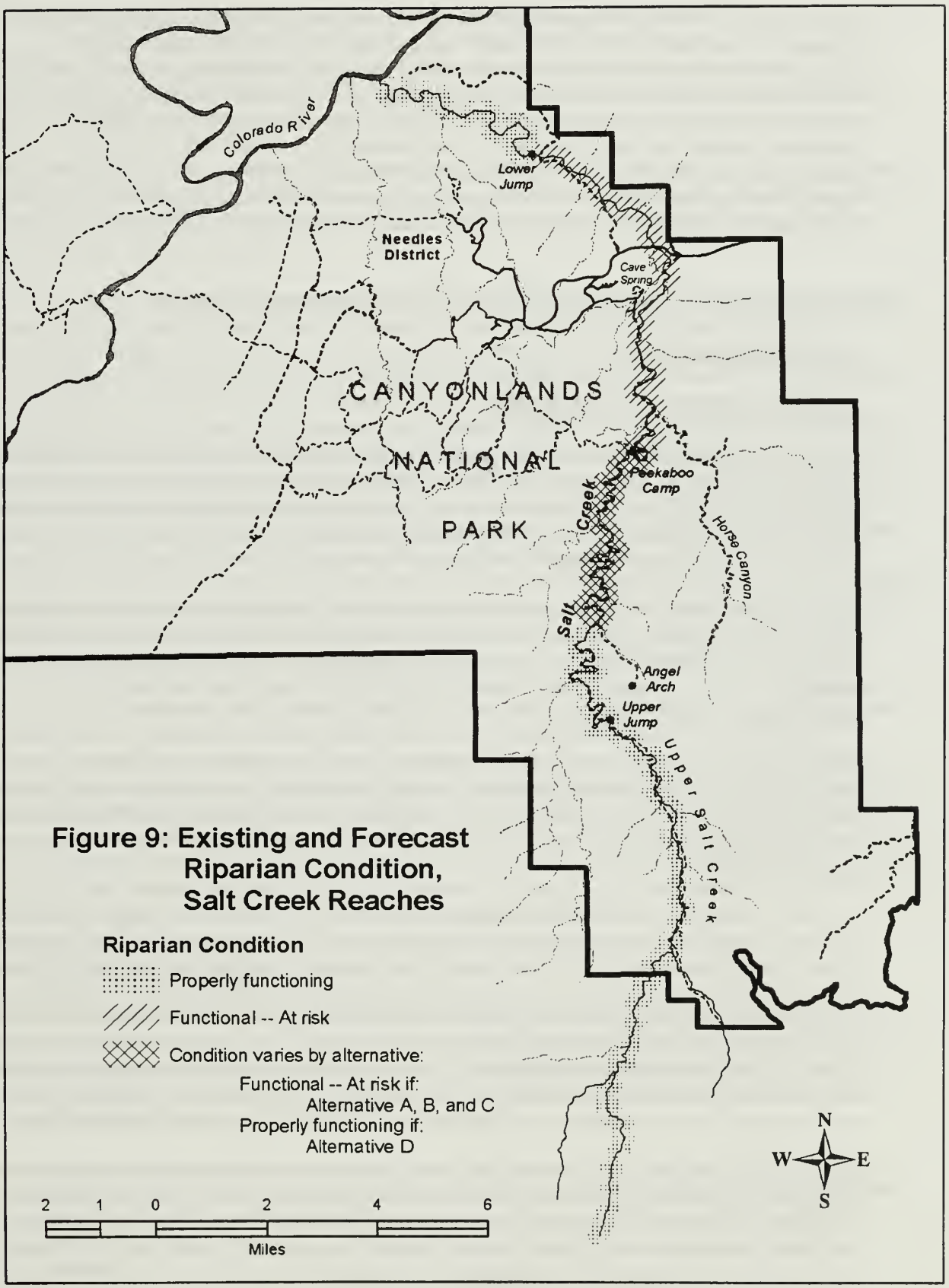


Figure 9: Existing and Forecast Riparian Condition, Salt Creek Reaches

Based on estimates of surface and ground water (see section 3.2.6.2) and riparian vegetation acreage (see section 3.2.6.3), Salt Creek supports the most extensive riparian area in Canyonlands National Park, other than the Green and Colorado Rivers. Surface water and riparian habitat are among the rarest habitat types in the arid Canyonlands environment, and are particularly important to wildlife. Salt Creek supports the richest assemblage of birds and other vertebrate wildlife in the park, outside the river corridors (see sections 3.2.1 and 3.2.2). For these reasons, the Salt Creek riparian/wetland ecosystem is a resource whose conservation is key to the natural integrity of the park. Consequently, the potential major indirect adverse impacts on this resource from this alternative constitute impairment of the park's resources and values.

4.2.6.2.2 Alternative B (Vehicle Access Part Year by Permit System)

Direct and Indirect Effects

Riparian/Wetland Functioning Condition

This alternative would affect the same types of characteristics (geomorphology, hydrology, vegetation, etc.) as alternative A. It would reduce the annual duration of vehicle travel in the riparian area. During the vehicle period of this alternative, surface water is likely to be less in extent and/or duration than during spring; if rainfall is light, portions of the channel may be dry. This may result in a slightly lower level of impact than from alternative A.

As with alternative A, the impact of vehicle travel on Salt Creek vegetation appears to be greater in channel sections with higher moisture, where riparian vegetation is or can be established (Inglis 2001). Drier, unvegetated sections may have a gravel or cobble substrate somewhat resistant to vehicle compaction and erosion (Inglis 2001), though they may also have the potential to accumulate fine sediment and support vegetation if not disturbed.

Research and management literature on livestock grazing suggests that stability of some streams may be less sensitive to trampling during periods when bank moisture levels and stream discharge are low and if the duration of the trampling is limited (Marlow et al. 1989, Chaney et al. 1990). Effects of livestock and vehicles differ in various ways, but both trample and compact vegetation and soil.

However, research on recreational impacts to soil and vegetation has found that, generally, the initial use causes most of the impact, and that additional use causes less and less additional impact (Hammitt and Cole 1987). As noted by the National Riparian Service Team (Elmore et al. 2001), this was demonstrated by an unauthorized vehicle trip on Salt Creek in May 2001, when damage to vegetation could be seen after only four vehicle passes. Many studies on recreational use have found that the loss of vegetation cover on lightly-used sites is nearly as substantial as the loss on heavily-used sites. Additionally, plant species vary in their vulnerability to trampling, and more resistant species, often exotics, may displace the original native inhabitants eliminated after trampling from recreational use (Hammitt and Cole 1987), reducing species diversity.

Though Salt Creek may be drier during the vehicle travel period under this alternative, a number of crossings of perennial pools or riparian vegetation would still be unavoidable. Riparian vegetation in these crossings would be reduced during the annual period of vehicle travel. In the next year's spring-summer growing season, some of this vegetation might begin to return, providing minor but temporary stabilization, but it would again be reduced by vehicles in the fall.

The result would be that some conditions (sinuousity, capture of streamflow by the road, etc.) that make the stream susceptible to indirect but major impacts would persist during the nonvehicle periods each year. Other conditions (vegetation and related channel roughness) might slightly improve during the non-vehicle periods, providing some dissipation of flood energy and increase in channel stability, so that a flood during this part of the year might have slightly less impact.

As with alternative A, impacts from hikers would generally be confined to the existing road/stream channel and existing trails. Discontinuous sections of foot trail, established adjacent to wetter sections of the road/channel, would continue to be used by hikers as well as vehicle travelers scouting flooded road sections.

As discussed in alternative A, post-1950s changes indicate that some improvement is possible despite vehicle traffic in Salt Creek. If visible improvement can occur with unlimited, then moderately limited, vehicle use, then it may be possible that some additional, gradual improvement could occur with further limitation as proposed by this alternative. This alternative would reduce the annual duration of direct impact from approximately nine months to approximately two months. It would also include an annual period without direct vehicle impact, during which there might be slight, though temporary, recovery. During the impact period there may be fewer wet areas traveled by vehicles, possibly reducing the extent of area susceptible to impact. Succession over time may proceed to a more sedge-dominated community (Elmore et al. 2001), which would increase resistance to impacts, though this progress may occur primarily outside vehicle tracks. These factors may result in slight improvement in the functioning condition of the riparian area in the long term. Until the riparian area reached properly functioning condition, however, flooding could cause a major setback to previous improvement at any time, and the recurrence interval of flood events that could cause such degradation, five to twenty years, suggests that it may occur before before properly functioning condition is attained.

The two Salt Creek reaches currently or formerly traveled by vehicles are both in functional—at risk condition. The Horse Canyon to Angel Arch junction section shows an upward trend, primarily in the part currently without vehicles, while no trend is apparent in the reach below Horse Canyon, still driven by vehicles. This functional but at risk condition, a minor direct impact, would be expected to continue from Peekaboo to Angel Arch junction, at least over the short to intermediate term (Prichard 2001), unless degraded by a five to twenty year flood. The condition rating of the riparian area would probably not improve until at least the long term, if ever. Until the riparian area reached properly functioning condition, it would be at risk of a major indirect impact from a five to twenty year flood; such an impact would persist long-term.

Area of Riparian/Wetland Disturbance

As with alternative A, the area of direct riparian disturbance would include the existing jeep road and occasional new detours around obstacles. Area of direct riparian disturbance would increase by one acre or less, remaining at about 6 acres (4.3 linear miles) between Peekaboo and the Angel Arch turnoff. This would be a direct impact of minor intensity, but somewhat lower than from alternative A because of intermittent vehicle travel.

As long as the riparian/wetland area remains in functional—at risk condition, there would be a potential for major indirect impact, substantially enlarging the impacted riparian area, from a five to twenty year flood. Probability of such an event would decrease if functioning condition improved.

The minor level of impact (direct) would continue for the long term (as long as vehicle travel

continues), unless a major indirect (flood) impact occurs. A major indirect impact would be possible at any time, and such an impact would persist long-term.

Water quality

The annual duration of direct water quality impacts would decrease to approximately two months. Vehicle effects would be intermittent over the course of the year. The potential for vehicle fluids leaking into the creek would be reduced due to the shortened period when vehicles would be present in the riparian area. Some vehicle-associated exceedences of sediment-related criteria (suspended solids, turbidity, phosphorus) would be expected during the approximately two months with vehicle travel. During the remainder of the year, residual effects from less-stable soils and ground cover are possible, but would be expected to be at lower levels than effects from active vehicle travel, as suggested by water quality monitoring results (Schelz 2001; see appendix __). The frequency of samples violating standards or exceeding pollution indicators may decrease from that occurring when vehicles are not limited by season. The creek's level of support for its designated uses would not be expected to change, so the direct water quality effects of this alternative would be considered minor to moderate and beneficial, when compared to the no action alternative (alternative A).

Water quality conditions would also be affected by the functional condition of the riparian area. Water quality may further improve if riparian functioning condition improves, but this would not be expected before the long term, if ever. Until properly functioning condition is reached, riparian condition could also deteriorate at any time from the indirect effect of flooding. Such degradation would likely prevent the creek from supporting its designated uses, thus would be considered a major water quality impact; duration would be long-term.

Cumulative Effects

Past, present and reasonably foreseeable future effects on the Salt Creek watershed, outside the project-specific effects of alternative B, would be as described under alternative A.

The project-specific effects from alternative B would result in 8.6 miles from Peekaboo to Angel Arch junction (21 percent of total Salt Creek length) remaining in functional—at risk condition long-term, unless degraded to nonfunctional condition first by a flood. The cumulative impact would thus be that a collective 18 miles, or 45 percent of the total creek length, would be in functional—at risk condition, with 22.2 miles, or 55 percent, in properly functioning condition (Figure 9). This is considered a moderate adverse cumulative impact, with the potential for a major cumulative impact.

Should the Peekaboo to Angel Arch progress to properly functioning condition (unlikely before the the long term) the cumulative effect would be a collective 30.8 miles, or 77 percent of the total creek length, in properly functioning condition, with 9.4 miles, or 23 percent, in functional—at risk condition. This would be considered a moderate beneficial cumulative effect.

Conclusion

This alternative would reduce the duration of direct vehicle impacts each year. During the non-vehicle period each spring and summer, vegetation might begin to return to the riparian/streambed portions of the road, providing minor but temporary improvement in flood energy dissipation and soil stability. Vehicle travel each fall, however, would reduce this vegetation to previous levels or thereabouts. This cycle of vegetation growth followed by removal

would hinder overall improvement in riparian functioning condition. The riparian area would not be expected to attain properly functioning condition before the long term, if ever. Until the riparian area reached PFC, geomorphic and vegetation characteristics would be inadequate to effectively dissipate flood energy and resist erosive force. While the riparian area would likely remain in functional—at risk condition for at least a short time, in this condition it would be vulnerable at any time to major degradation, rendering the riparian area nonfunctional, from a flood of a magnitude that recurs regularly (five to twenty year recurrence interval). A riparian area in properly functioning condition would withstand such a flood.

The limited vehicle travel period would be expected to reduce potential for vehicle fluid impacts, as well as the frequency of exceedences of sediment-related water quality criteria, compared to the no action alternative (alternative A), which would be considered a direct, minor to moderate, beneficial effect on water quality, as long as the riparian area is in functional—at risk or properly functioning condition. Should an indirect flood impact degrade the riparian area to nonfunctional condition, however, this would also cause a major adverse impact to water quality.

While the direct impact of vehicle traffic would be minor on functional condition and amount of riparian area disturbed, the indirect impact, from a fairly commonplace flood, would be major on these two characteristics as well as on water quality. Such a major impact would persist long term, since recovery is greatly impeded when riparian areas become nonfunctional. Cumulatively, approximately 45 percent of the total Salt Creek stream length would continue in functional at—risk condition long term, unless or until major indirect adverse impact from flooding occurs.

The direct adverse impact of this alternative on the riparian/wetland ecosystem would be less than that of alternatives A and C, and greater than that of alternative D. Potential indirect (flood) impacts, however, would be similar to those from alternatives A and C, and would likely occur before the riparian system reached a point (properly functioning condition) at which it could withstand such flooding. Additional mitigation measures such as clearly delineating the road would not eliminate this risk. Consequently, this alternative would not fully mitigate this impact.

Based on estimates of surface and ground water (see section 3.2.6.2) and riparian vegetation acreage (see section 3.2.6.3), Salt Creek supports the most extensive riparian area in Canyonlands National Park, other than the Green and Colorado Rivers. Surface water and riparian habitat are among the rarest habitat types in the arid Canyonlands environment, and are particularly important to wildlife. Salt Creek supports the richest assemblage of birds and other vertebrate wildlife in the park, outside the river corridors (see sections 3.2.1 and 3.2.2). For these reasons, the Salt Creek riparian/wetland ecosystem is a resource whose conservation is key to the natural integrity of the park. Consequently, the potential major indirect adverse impacts on this resource from this alternative constitute impairment of the park's resources and values.

4.2.6.2.3 Alternative C (Road Realignment)

Direct and Indirect Effects

Riparian/Wetland Functioning Condition

Alternative C would reduce the length of jeep road within the riparian area, from about 4.3 miles to about 3 miles, out of the 7.2 road miles from Peekaboo to the Angel Arch turnoff. An estimated 0.5 miles would be new road created in riparian area; the remainder would be existing road that

would continue to be used in riparian area.

Because of the discontinuous nature of the terraces bordering the stream, the relocated road would still have to swing back and forth across the channel to terraces on opposite sides. The terraces are five to 30 feet above the streambed, and each would require climbs/descents to the stream level at one or both ends. The terraces are uniform sand (Inglis 2001), incohesive if the stabilizing effect of plant roots and cryptobiotic crust is removed. Approximately 30 to 40 new climbs from streambed to terrace would be required, which would replace road sections currently in the riparian area.

The number of stream crossings would be reduced from over 60 to over 40. Webb (2001) recommended that stream channel crossings be aligned perpendicular to the stream channel to minimize erosion during floods. Because of the closeness of terrace banks to the channel and their height, perpendicular channel crossings may not be possible in every case. For several of the climbs from stream level to terrace, substantial road cuts would need to be excavated, either perpendicular or parallel to the banks, in order to reduce the steepness to a passable grade.

Existing terrace crossings, which are generally lower than those underlying the proposed realignments, are entrenched from erosion (Inglis 2001). New crossings would also be erosive, likely of greater magnitude because of their greater height and longer slope distance necessary to climb these elevations at manageable grades. Erosion would destabilize vegetation, potentially including old cottonwoods which are increasingly uncommon regionally (Webb 2001, Carothers 2001).

While road beds on the terrace climbs would be artificially stabilized or surfaced to reduce erosion and improve vehicle traction, the cut slopes above the road beds would be subject to accelerated erosion, providing a substantial new source of sediment into the creek bed. This increased sediment load would be expected to cause changes in stream morphology, such as braiding and lateral channel migration.

As with alternatives A and B, impacts from hikers would generally be confined to the road, stream channel, and existing trails. Use of trail sections adjacent to wet parts of the road/channel would decrease, as the length of road in the channel, which these sections were established to avoid, would decrease.

The National Riparan Service Team suggested that the opportunities for relocation of the jeep road out of the streambed would not be adequate to allow the riparian area to reach proper functioning condition (Elmore et al. 2001). While this alternative would reduce the total riparian area directly impacted and the number of stream crossings, there would be new disturbance to incohesive terrace banks, new sources of erosion and sedimentation, and consequent indirect effects to riparian functioning. Additional instability on terrace slopes (30-40 new climbs) may increase sedimentation into the creek, offsetting some of the benefits of removing road sections from the riparian area.

Some initial decline in riparian trend, a moderate direct impact, may occur in the short to intermediate term, due to new disturbance. The downward trend may diminish as vegetation recolonizes abandoned road/channel sections in the intermediate to long term, though the riparian system would remain in functional--at risk condition. While the riparian system in this condition would be marginally functional, it would be vulnerable at any time to major indirect adverse impacts from five- to twenty-year floods. Duration of such impacts would be long term, since recovery time increases considerably when riparian areas become nonfunctional (Prichard

et al. 1998).

Area of Riparian/Wetland Disturbance

Amount of riparian area directly disturbed would be reduced in the intermediate to long term. This alternative would reduce the area of jeep road in the riparian/wetland area by approximately 30 percent, from 5.7 acres (4.3 linear miles) to about 4 acres (3.0 linear miles). This would be a direct beneficial impact of minor intensity.

In the short to intermediate term, existing disturbed areas would persist, while there would be additional direct adverse riparian/wetland impact of minor intensity, about 0.5 acres, on relocated road sections and on informal detours around impassable areas. During this period there would be increased vulnerability to indirect flood impacts, as both abandoned and newly created riparian road sections would be vulnerable. Vegetation would return to former vehicle tracks in the intermediate to long term, unless major indirect flood impacts occur first.

The riparian/wetland area would remain at risk of indirect effects of road-aggravated flooding, as discussed under Functioning Condition above. Flooding of a magnitude that recurs regularly could substantially increase the size of the impacted riparian area. This would be an indirect effect of major intensity, long-term in duration.

Water Quality

This alternative would reduce the extent of the stream channel traveled by vehicles compared to the no action alternative (alternative A), and the number of crossings, including in wetter stream sections which are more likely to have surface water susceptible to impacts of vehicle travel. The potential for vehicle fluids leaking into the creek would be somewhat reduced due to the lower length of riparian area exposed to this risk. However, these benefits would be offset by the substantial new contribution of sediment from the relocated tracks on unstable terrace slopes, with the result that water quality would not be expected to improve. Thus this alternative would have moderate direct adverse impacts, continuing long-term. As with alternative A, the risk of major indirect effects resulting from road-aggravated degradation of the riparian area would continue in the long term.

Cumulative Effects

Cumulative effects of alternative C would be the similar to those of alternative A. The Peekaboo to Angel Arch section, 21 percent of the total creek length, would continue in functional—at risk condition. This would result in a cumulative 45 percent of the creek length in this condition, with 55 percent in properly functioning condition (Figure 9). This is considered a moderate cumulative impact, with the potential for a major cumulative impact.

Conclusion

This alternative would reduce the area of direct riparian/wetland disturbance by about 30 percent compared to the no action alternative, a minor direct beneficial effect. However, substantial indirect increases in sedimentation, from new road cuts through incohesive sandy terraces, would offset this benefit, and the riparian area would not be expected to reach properly functioning condition. Geomorphic and vegetation characteristics where vehicles travel the streambed and riparian area would be inadequate to effectively dissipate flood energy and resist erosive force. While the riparian area would likely remain in functional—at risk condition for at least a short time,

in this condition it would be vulnerable at any time to major degradation, rendering the riparian area nonfunctional, from a flood of a magnitude that recurs regularly (five to twenty year recurrence interval). A riparian area in properly functioning condition would withstand such a flood. While the direct adverse impact of vehicle traffic would be minor to moderate on riparian condition and water quality, the indirect impact, from a fairly commonplace flood, would be major on these characteristics as well as on total area of riparian/wetland disturbance. Such a major impact would persist long term, since recovery is greatly impeded when riparian areas become nonfunctional. Cumulatively, approximately 45 percent of the total Salt Creek stream length would continue in functional at—risk condition long term, unless or until major indirect adverse impact from flooding occurs. The adverse impact of alternative C on the riparian/wetland ecosystem would be comparable to that of alternative A, and greater than that of alternatives B and D.

Though this alternative would cause a lower level of direct impact than unlimited vehicle use, substantial portions of the road would remain within the streambed and riparian area, and additional sources of instability would be created. The likelihood of a major indirect impact from a fairly commonplace flood event would continue. Additional mitigation measures, such as clearly delineating the road and surfacing terrace road cuts, would not eliminate these impact sources. Consequently, this alternative would not fully mitigate this impact.

Based on estimates of surface and ground water (see section 3.2.6.2) and riparian vegetation acreage (see section 3.2.6.3), Salt Creek supports the most extensive riparian area in Canyonlands National Park, other than the Green and Colorado Rivers. Surface water and riparian habitat are among the rarest habitat types in the arid Canyonlands environment, and are particularly important to wildlife. Salt Creek supports the richest assemblage of birds and other vertebrate wildlife in the park, outside the river corridors (see sections 3.2.1 and 3.2.2). For these reasons, the Salt Creek riparian/wetland ecosystem is a resource whose conservation is key to the natural integrity of the park. Consequently, the potential major indirect adverse impacts on this resource from this alternative constitute impairment of the park's resources and values.

4.2.6.2.4 Alternative D (Vehicles Prohibited All Year)

Direct and Indirect Effects

Riparian/Wetland Functioning Condition

This alternative would continue the management in effect since summer 1998 for the Peekaboo to Angel Arch section. Under this management, riparian vegetation is colonizing sections with higher moisture availability where vehicles formerly crossed the channel or riparian area. This colonization would be expected to continue under this alternative, improving channel and floodplain stability, capturing fine sediment, dissipating flood energy, and improving water retention. Other processes and conditions altered by vehicle travel would also be expected to improve:

- Channel width/depth ratio would decrease
- Channel sinuosity and associated lateral channel movement would increase
- Connection between channel and floodplain or overflow channels would increase

A possible result of this alternative would be an eventual increase in duration of streamflow and height of the water table, as riparian vegetation increases and alluvial sediment accumulates

along the channel and floodplain (see e.g. Elmore and Beschta 1987, Chaney et al. 1989, DeBano and Hanson 1989, Hanson and Kiser 1988, Heede and DeBano 1984).

A designated hiking trail would follow the existing travel way. The width of disturbed area would decrease in wetter sections, as riparian vegetation returned to the vehicle tracks. Discontinuous sections of foot trail that detour around wet sections of the channel would continue to be used.

Based on the riparian functioning condition assessment (Elmore et al. 2001), this section under a vehicle prohibition would be expected to be in functional—at risk condition, with an upward trend, in the short to intermediate term. The continuing upward trend would be expected to culminate in this section reaching proper functioning condition in the intermediate to long term, which would be a major direct beneficial effect.

Until the riparian area reached properly functioning condition, it would be at risk of a major indirect impact from flooding as discussed under previous alternatives. This condition and risk, however, would result more from a previous, discontinued use (vehicle traffic) than from use due to this alternative, though continued hiking use would be a minor contributor to this condition.

Area of Riparian/Wetland Disturbance

Riparian vegetation would be expected to return to the sections of road in the riparian area, except for a foot trail which would continue to be used. The length of existing road in the riparian area is about 4.3 linear miles, covering an estimated 5.7 acres. This disturbed area would persist for the short to intermediate term. After return of vegetation in the intermediate to long term, a three-foot wide trail would remain, reducing the area of direct riparian disturbance by about 4 acres, to about 1.6 acres. This would be would be a direct beneficial effect of moderate intensity.

Water Quality

Water quality monitoring data from roadless Salt Creek pools suggests that violations or exceedences of sediment-related parameters (suspended solids, turbidity, phosphorus) would be less in frequency and magnitude than from vehicle alternatives, but may not disappear entirely. Residual indirect effects from road-related runoff and erosion would decrease over time as parts of the road, streambanks and floodplain were recolonized by vegetation. A foot trail would remain along parts of the creek, which would continue to contribute small amounts of sediment to surface water.

Overnight use, particularly dispersed backpack camping, may increase in this section of Salt Creek as a result of prohibition of vehicle travel, though the amount of potential increase is limited by provisions in the Canyonlands Backcountry Management Plan. This plan also established various provisions to protect water quality, including a requirement that campsites be located at least 300 feet from water sources. Overnight backpacking use in the Salt Creek/Horse Canyon zone, which includes this section of Salt Creek, fluctuates from month to month and year to year, but some months have had increased use since vehicles were prohibited in 1998. A potential effect of this increased use would be increases in fecal coliform bacteria, which indicates pollution from human waste. However, no violations in fecal coliform standards have been detected at Salt Creek sites from 1995 to present, even in months with substantial increases in overnight backpacking use since 1998 (in most Salt Creek samples since the vehicle prohibition, no coliform bacteria have been detected). These results suggest that this potential impact would be sucessfully mitigated. Consequently, no reduction in Salt Creek's support of its designated uses as a result of fecal coliform violations would be expected from this alternative. (For research on

this question, see Hammitt and Cole 1987, and Aukerman and Springer 1976.)

Dissolved oxygen levels would be expected to be comparable to current levels for non-vehicle sections of Salt Creek. The frequency of dissolved oxygen standard violations in both vehicle and non-vehicle sample sites on Salt Creek is currently at the non-use-support level for designated use 3B (warmwater aquatic life).

Sediment-related parameters would be expected to improve under this altemative. Other water quality parameters would not be expected to decline. Thus the net water quality effect, beginning in the short term and continuing long-term, would be considered moderate and beneficial.

Cumulative Effects

Past, present and reasonably foreseeable future effects on the Salt Creek watershed, outside the project-specific effects of altemative D, would be as described under altemative A.

The project-specific effects from altemative D would result in 8.6 miles from Peekaboo to Angel Arch (21 percent of total Salt Creek length) improving to properly functioning condition in the intermediate to long term, unless degraded first by a flood. The cumulative result would be that 30.8 miles, or 77 percent of the total creek length, would be in properly functioning condition, with 9.4 miles, or 23 percent, in functional—at risk condition (Figure 9). This is considered a moderate beneficial cumulative effect compared to the no action alternative (alternative A).

Conclusion

Under this alternative, the upward trend on the Peekaboo to Angel Arch section would be expected to continue, culminating in the riparian area improving to properly functioning condition in the intermediate to long term. In this condition, the riparian area would withstand floods of magnitude that recurs regularly (five to twenty year recurrence intervals) without major degradation. This would be considered a major direct beneficial effect for riparian functioning condition. The area of direct riparian/wetland disturbance would be reduced by about 4 acres, a moderate beneficial effect.

Sediment-related water quality parameters would be expected to improve as vegetation coverage increased along riparian road sections, reducing erosion and sedimentation. Other water quality parameters would not be expected to decline. Thus the net water quality effect would be considered moderate and beneficial.

Risk of major indirect impact to these characteristics from regularly-recurring flooding (five- to twenty-year recurrence intervals) would begin declining in the short term, concurrent with the upward trend in riparian functioning condition. In the intermediate to long term this risk would be expected to be sucessfully mitigated as the riparian area attained properly functioning condition. Cumulative effects would be moderate and beneficial. This altemative would have the most beneficial effects on the riparian/wetland ecosystem.

Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the parks's general management plan or other relevant NPS planning documents, this alternative would not cause impairment of the park's resources or values.

4.2.7 Economic Environment

4.2.7.1 Methodology for Evaluating Impacts and Significance (Context, Duration, Intensity)

Forecasts for economic impacts are based on actual park visitation and commercial revenue data from periods when alternatives A or D were in effect (from 1995 through June 1998, and July 1998 to present). Sources include parkwide and Salt Creek-specific visitation data collected by the NPS (NPS 1993-2000), estimates from the NPS Money Generation Model (Homback 1990), and annual gross receipts figures submitted by tour companies. Trends under limited and no vehicle use above Peekaboo were analyzed and compared.

Measures of visitation were used as indicators of direct sales associated with park visitation, and therefore as indicators of economic impacts. Economic effects were analyzed in several contexts:

- Effects on overall visitation (commercial and noncommercial) parkwide
- Effects on overall Salt Creek-specific visitation
- Effects on land-based commercial revenue parkwide, overall and sector-specific (vehicle tours, backpacking, mountain biking)
- Effects on commercial business (recreation visitor-days), Needles district and Salt Creek-specific

The no action alternative (alternative A) served as the baseline for comparison. Year to year fluctuations that occurred in the parameters above under alternatives A and D were analyzed and compared; likely effects from alternatives B and C were inferred from this data.

The following definitions apply to impact descriptions for the economics category:

Duration:

- Short term: lasting up to a year
- Intermediate term: lasting from a year to a few years
- Long term: lasting several years to permanently

Intensity:

Intensity of impacts was evaluated according to the range of fluctuation and direction of change (upward or downward) from year to year, comparing statistics associated with alternatives A and D. Thresholds for intensity ratings were as follows:

- Negligible: Within, or less than 1 percent outside, the annual average range of fluctuation for the no action alternative
- Minor: 1 to 5 percent outside the annual average range of fluctuation for the no action alternative (i.e. above the upward fluctuations or below the downward fluctuations)

- Moderate: 5 to10 percent outside the annual average range of fluctuation for the no action alternative
- Major: Over 10 percent outside the annual average range of fluctuation for the no action alternative

4.2.7.2 Alternative Comparison

4.2.7.2.1 Impacts Common to All Alternatives

Park staffing requirements would be similar between alternatives. None of the contemplated alternatives propose major construction. Consequently, NPS spending would not differ substantially between alternatives.

Use of the Peekaboo to Angel Arch section of Salt Creek has accounted for about 1 percent of Canyonlands National Park visitors on average in recent years, and 1.5 percent of park recreation visitor-days (RVDs), whether or not vehicles were permitted above Peekaboo. Many Salt Creek travellers visit other park destinations as well. Thus changes in Salt Creek visitation, as a result of one of the alternatives, would have minimal effect on overall park visitation and resulting economic impact. Even if all potential Salt Creek visitors were to forego their park visits entirely due to one of the alternatives, reducing total park recreation visitor-days by 1.5 percent, this would be within the 2.5 percent average annual fluctuation in parkwide RVDs (see section 3.2.7.1), hence a negligible effect to overall visitation. If potential Salt Creek visitors forego a trip to Salt Creek, but still visit elsewhere in the park, the impact on total park visitation would be less. If substantial additional numbers of visitors came to Salt Creek who would not otherwise visit the park, due to one of the alternatives, the impact parkwide would probably not be more than minor (e.g., if the previously highest number of Salt Creek visitor-days doubled, this would increase total park RVDs by about 1.5 percent, which is within the average range of annual fluctuation in parkwide RVDs and thus a negligible impact).

4.2.7.2.2 Alternatives A (Vehicle Access All Year by Permit System) and C (Road Realignment)

Direct and Indirect Effects

Economic effects from park visitation and concession revenues would be expected to continue within the range of fluctuation that occurred during the period alternative A was in effect (from 1995 to June 1998).

Wide fluctuations in annual totals of day-use vehicles (both commercial and noncommercial) occurred when alternative A was in effect (see Figure 4). Annual totals ranged from 886 to 1849. Fluctuations averaged over 50 percent up or down each year between 1995 and 1997, followed by a 26 percent rise in 1998, during which vehicles were permitted through June. This range of annual fluctuations, in use and related economic effects, would be expected to continue under these two alternatives.

In 1998, vehicle day use generated an estimated 70 percent of the total annual Salt Creek use, vehicle camping about 15 percent, and backpacking about 15 percent (see Figure 5). Similar

portions of total use would be expected to occur under these alternatives, with the result that the wide annual fluctuations in vehicle day use would also cause wide fluctuations (35 percent or more) in total Salt Creek use (commercial and noncommercial) and related economic effects. (NPS does not have detailed data on use other than vehicle use prior to 1998.)

Based on data fom the period alternative A was in effect, commercial Salt Creek vehicle trip use and associated revenue would be expected to fluctuate an average of over 50 percent up or down annually (see Figure 6).

Revenue from Salt Creek vehicle trips would be expected to produce some fraction of the 39-46 percent of total park land-based revenue generated by vehicle trips parkwide (see Figure 8). During years this alternative was in force, Salt Creek vehicle trips generated about half of the commercial vehicle RVDs for the Needles district (see Figure 6), one of three park districts with vehicle trips.

Parkwide commercial vehicle revenue may vary independently of Salt Creek commercial vehicle use. During the period alternative A was in force, parkwide vehicle revenue declined in years Salt Creek use increased, and vice versa (see Figure 6). Similarly, total revenue trends from land-based trips (vehicle, mountain bike, backpack, and photography trips) may vary independently from the trend in vehicle trips (see Figure 8). Changes in other sectors may offset or surpass changes in vehicle tour use.

Cumulative Effects

Cumulative impacts include those of various past, present and reasonably foreseeable future actions, both within immediate project impact zone and outside the project impact zone but within the Needles district and Canyonlands National Park, combined with impacts from these alternatives ("project-specific impacts"). These include both adverse and beneficial effects. Various cumulative economic effects of park-wide and Needles district visitor spending and commercial services revenue were discussed previously, in order to provide context in which to evaluate impacts from Salt Creek-specific alternatives.

Recreation has been the primary source of economic outputs from Salt Creek and the surrounding Needles district of Canyonlands National Park since the mid-1970s, when livestock grazing ceased within the park. From 1964, when the park was created, until the mid-1970s, both tourism and grazing generated revenue, with an increasing share, corresponding to the growth in park visitation, coming from tourism over this period. Prior to 1964, grazing was the primary economic producer in the Needles area, supplemented in the 1950s by an infant tourist industry and uranium prospecting. Since the creation of the park, visitation has grown approximately twelve-fold; visitor spending is assumed to correspond. Federal government spending for development and management of the park, as well as payments in lieu of taxes, have been additional sources of income. Revenue from these sources has probably far surpassed the income lost when grazing was phased out within the park.

Salt Creek commercial vehicle use would contribute to cumulative economic impacts from overall park commercial vehicle tours. Overall park vehicle tour revenue declined about 3 percent from 1995 to 1997, then 15 percent in 1998, but Salt Creek vehicle tour activity increased during this period, apparently keeping this cumulative adverse effect from being larger. The decline in overall vehicle revenue may be due primarily to broader tourism trends, since the park has not taken action that might reduce parkwide commercial vehicle use since 1995.

The only existing and or reasonably foreseeable activity within the Needles district with potential cumulative economic effects is recreation. Total recreation visitor numbers and commercial services revenues are expected to continue to fluctuate from year to year, but to be a continuing, long-term source of income. Federal govemment spending for ongoing park management would continue for the foreseeable future, supplemented by periodic additional federal spending for short term construction, resource management, interpretation and other projects. While there may be short term incremental fluctuations up or down as a result of this alternative or other actions, the long term trend would be expected to continue within the past range of fluctuations. Within the context of the overall economies of San Juan and Grand Counties, visitor and park spending would continue to provide cumulative minor to moderate economic contributions.

Conclusion

Based on data from the period when alternative A was in effect (1995 through June 1998), the following economic effects would be expected from alternatives A and C:

- Salt Creek vehicle use (noncommercial and commercial) and related economic effects would fluctuate over 50 percent per year up and down.
- Vehicle day use would generate about 70 percent of the total annual Salt Creek use and associated economic effects, resulting in continuing wide fluctuations (35 percent or more) in total Salt Creek use (which includes vehicle camping and backpacking).
- Salt Creek concession vehicle use and related economic effects would fluctuate an average of 50 percent per year.
- Salt Creek vehicle trips would generate about half of the commercial vehicle use, and related revenue, in one of the three park districts with vehicle trips; total vehicle revenue from all three districts would account for about 45 percent of total land-based commercial park revenue (vehicles, mountain bikes, backpacking, photography).
- Because of wide fluctuations, variations in other commercial uses (destinations or activities) may offset or surpass economic effects from changes in Salt Creek use

Short term incremental fluctuations up or down would be expected, but the long term trend would be expected to continue within the past range of fluctuations. This would be a negligible economic effect in the long term.

4.2.7.2.3 Alternative B (Vehicles Access Part Year by Permit System)

Direct and Indirect Effects

Annual numbers of day use vehicles on the Salt Creek road, including Horse Canyon, fluctuated widely under alternative A (vehicles permitted above Peekaboo), but were generally higher than under alternative D (vehicles prohibited above Peekaboo) (see Figure 4). Based on this trend, vehicle use and related economic effects under alternative B would be expected to be somewhat above the levels in alternative D. Year to year fluctuations would be expected to continue, but not to exceed the range of fluctuation from alternative A.

Data from alternatives A and D indicates that the portions of different types of use, particularly vehicle day use and backpacking, shifted depending on which alternative is in effect. When vehicles were prohibited, backpacking use increased, offsetting the decrease in vehicle use (see Figure 5). These shifts in use in the Salt/Horse zone (including Horse Canyon) would be expected to occur over the course of the year with this alternative, with most backpacking

occurring in the spring and most vehicle day use occurring in the summer and fall. Annual fluctuations in total use and related economic effects would not be expected to exceed the range from alternative A.

Since the highest annual levels of Salt Creek concession vehicle use were reached when vehicles were prohibited above Peekaboo for part (1998) or all (2000) of the year, alternative B would not be expected to reduce this level of use and related economic effects. This alternative may result in some additional increase in this use, but increases would be expected to be minor, since the period vehicles would be permitted above Peekaboo is outside the primary commercial use season (May to September). Annual fluctuations would not be expected to exceed the range from alternative A.

Salt Creek vehicle use has accounted for an increasing portion of the commercial vehicle RVDs for the Needles district in recent years, from 70 to 90 percent (see Figure 6), and thus of vehicle revenue parkwide. However, vehicle use in two other park districts, as well as at other destinations in the Needles, also generate substantial shares of total vehicle revenue. Hence a continued increase in Salt Creek commercial vehicle use would not ensure a corresponding increase in parkwide commercial vehicle. Similarly, vehicle revenue, Salt Creek-specific or parkwide, may vary independently from total land-based commercial revenue (which also includes mountain bike, backpack and photography trips; see Figure 8). Changes in other sectors may offset or surpass changes in vehicle tour use, reducing the economic effect of vehicle use.

Cumulative Effects

Past, present and reasonably foreseeable future effects on the Needles district and Canyonlands National Park, outside the project-specific effects of alternative B, would be as described under alternatives A and C. In general, park-related spending has outweighed the revenue lost since the mid-1970s when grazing ceased within the park.

Gross revenue for commercial vehicle tours parkwide declined about 18 percent between 1995 and 2000. However, Salt Creek-specific vehicle RVDs concurrently generally increased, under both alternatives A and D. Thus Salt Creek activity, under either of these alternatives, has apparently incrementally reduced this cumulative adverse effect. Since alternative B is intermediate between alternatives A and D, it would not be expected to change this effect. (The parkwide revenue decline may be due primarily to broader tourism trends.)

The only existing and or reasonably foreseeable activity within the Needles district with potential cumulative economic effects is recreation. Park visitation, concession revenues, and federal park spending will be continuing long term sources of income, providing cumulative minor to moderate economic contributions within the context of the overall economies of San Juan and Grand Counties. This alternative would not be expected to increase the range of annual fluctuations above that under the no action alternative.

Conclusion

Economic effects of this alternative would be expected to be intermediate between those of alternatives A and C and alternative D:

- Annual numbers of Salt Creek day use vehicles (private and commercial) and related economic effects would be somewhat higher than under alternative D, with annual

fluctuations not exceeding those under alternative A.

- Shares of total use generated by vehicle day use, vehicle camping, and backpacking would be expected to vary over the course of the year, according to whether vehicles were permitted above Peekaboo. Annual fluctuations would not exceed those from alternative A.
- Salt Creek concession vehicle use and related revenues would be expected to continue at or near previous highest levels (1998 and 2000), within the range of fluctuation of alternative A.
- The effects of vehicle revenue, Salt Creek-specific or parkwide, are not expected to increase the range of fluctuation in overall land-based commercial revenue. These trends would be expected to continue under alternative B.

Short term incremental fluctuations up or down would be expected, but the long term trend would be expected to continue within the range of fluctuations under alternative A. This would be a negligible economic effect in the long term.

4.2.7.2.4 Alternative D (Vehicles Prohibited All Year)

Direct and Indirect Effects

Economic effects from park visitation and commercial services would be expected to continue within the range of fluctuation that occurred during the period this alternative was in effect (after June 1998).

Annual numbers of total day-use vehicles (commercial and noncommercial) in Salt Creek (below Peekaboo) and Horse Canyon ranged from 807 to 905 under alternative D. Annual fluctuations in total numbers have averaged 13 percent up or down under this alternative, with a drop of 28 percent in 1999 and increases of 3 percent and 9 percent, respectively, in 2000 and 2001. This compares to average annual fluctuations over 50 percent under alternative A. Fluctuations in vehicle use and related economic effects would be expected to continue each year under alternative D, but would not be expected to increase beyond the range of annual fluctuation that occurred under alternative A.

Backpacking and vehicle camping use increased substantially in the Salt/Horse backcountry zone under alternative D, backpacking nearly 100 percent and vehicle camping at Peekaboo 25 percent (see Figure 5). This offset a decrease in vehicle day use and resulted in total use (vehicle day trips, vehicle camping, and backpacking) of this zone rising over 5400 visitor-days, exceeding the highest levels under alternative A by about 2 percent. (If only the January-June period is counted, which compares the 1998 months when vehicles were permitted to the same months in subsequent years, combined use for January through June in 2000 and 2001 was 21 percent above the same period in 1998.) Total combined use for the Salt Creek/Horse Canyon zone has fluctuated an average of 15 percent per year, with an upward trend, under alternative D. Fluctuations in total use and related economic effects would be expected to continue within this range, compared to 35 percent or more under alternative A.

Commercial Salt Creek vehicle trip RVDs fluctuated an average of 19 percent up or down under alternative D. The highest levels for this use were recorded in the years alternative D was in effect (see Figure 6): 612 visitor-days in 1998 (when alternative D was in effect for half the year), and 600 visitor-days in 2000. This range of fluctuation in use and related economic effects would be expected to continue under alternative D, compared to over 50 percent under alternative A.

Though the Angel Arch vehicle trip is a popular one, visitors and concessioners have a number of other options if this trip is unavailable for vehicles, including starting on Salt Creek then continuing into Horse Canyon. Numbers of customers on Salt Creek/Horse Canyon trips in 2000 compared to previous years indicate that this is a marketable option.

Parkwide commercial vehicle revenue was lower under alternative D than in previous years, in spite of Salt Creek commercial vehicle use being at the highest levels (see Figure 6). Declining revenue from other vehicle destinations may offset or surpass increases in Salt Creek revenue.

Revenue from Salt Creek vehicle trips would be expected to produce some fraction of the 31-35 percent of total park land-based revenue generated by vehicle trips parkwide (see Figure 8). During years this alternative was in force, Salt Creek vehicle trips generated 70 to 90 percent of the commercial vehicle use for the Needles district (see Figure 6), one of three park districts with vehicle trips.

Overall land-based commercial revenue parkwide (which also includes mountain bike, backpack and photography trips) increased to a high while alternative D was in effect, eight percent above the high under alternative A, and fluctuated an average of 12 percent per year (see Figure 8). Total land-based revenue may vary independently from vehicle revenue, Salt Creek-specific or parkwide. Changes in other sectors may offset or surpass changes in vehicle tour use.

Cumulative Effects

Past, present and reasonably foreseeable future effects on the Needles district and Canyonlands National Park, outside the project-specific effects of alternative B, would be as described under alternatives A and C. In general, park-related spending has outweighed the revenue lost since the mid-1970s when grazing ceased within the park.

While alternative D was in effect, overall Needles district commercial vehicle RVDs decreased each year, dropping a total of 16 percent. Salt Creek commercial vehicle RVDs parallelled total park commercial vehicle revenues during this period, with decreases in 1999, but returns in 2000 to approximately 1998 levels (see Figure 6). Based on this data, Salt Creek use under alternative D would incrementally reduce the cumulative adverse effect on total park commercial vehicle revenue, from recent trends in declining commercial vehicle use elsewhere in the Needles district.

The only existing and or reasonably foreseeable activity within the Needles district with potential cumulative economic effects is recreation. Park visitation, concession revenues, and federal park spending will be continuing long term sources of income, providing cumulative minor to moderate economic contributions within the context of the overall economies of San Juan and Grand Counties. This alternative would not be expected to increase the range of annual fluctuations above that under the no action alternative.

Conclusion

Based on data from the period when alternative D was in effect, the following economic effects would be expected from this alternative:

- Salt Creek annual vehicle use (noncommercial and commercial) and related economic effects would be lower than the highest level reached under alternative A, but within the range of fluctuation exhibited under alternative A.
- Combined Salt Creek use (vehicle day use, vehicle camping, and backpacking) and related

economic effects would be slightly higher than the highest levels reached under alternative A
- Salt Creek concession vehicle use reached its highest levels under alternative D, hence revenue from this use would not be reduced as a result of this alternative
- Because of wide fluctuations, variations in other commercial uses (destinations or activities) may offset or surpass economic effects from changes in Salt Creek commercial use

Short term incremental fluctuations up or down would be expected, but the long term trend would be expected to continue within the past range of fluctuations. This would be a negligible economic effect in the long term.

4.2.8 Wilderness

4.2.8.1 Introduction

The Salt Creek jeep road is bordered on both sides by land recommended for wilderness designation by the NPS and the Secretary of Interior (NPS 1974). NPS policy is that lands recommended for wilderness are to be managed to maintain their wilderness characteristics until Congress acts on the recommendations (NPS 2001, 1999).

The Canyonlands wilderness recommendation (NPS 1974) describes non-wilderness road corridors as follows:

> The recommended wilderness is approximately 300 feet from the centerline of major roads, and approximately 150 feet from the centerline of other other roads, except where topographic features provide a more logical wilderness boundary or where more non-wilderness space is needed. Any setback from a road centerline is approximate; the wilderness will be described legally by a topographic or general land-survey description.

4.2.8.2 Methodology for Evaluating Impacts and Significance (Context, Duration, Intensity)

Acreage and linear feet of new four-wheel-drive road potentially affecting recommended wilderness was estimated from on-site global positioning system (GPS) location of alternative road alignments, a computer geographic information system (GIS) and aerial photographs.

Intensity thresholds are based on the degree or magnitude of "non-conforming uses" within Canyonlands recommended wilderness areas, in duration (length of time) and/or area (acreage) of effect. Nonconforming uses are activities which are generally prohibited within wilderness, such as temporary roads, mechanized vehicles or equipment, structures, or installations, but which may be allowed if necessary to meet the minimum requirements for administration of an area for wilderness purposes.

The following definitions apply to impact descriptions for the wilderness category:

Intensity:

- Negligible: Degree of nonconforming use is negligible in area and/or very short-term (a day or less) in duration, and would not cause a fundamental change in the character of Canyonlands recommended wilderness
- Minor: Degree of nonconforming use is minor in area and/or short-term in duration, and would not cause a fundamental change in the character of Canyonlands recommended wilderness
- Moderate: Degree of nonconforming use is moderate in area and/or intermediate-term in duration, and would not cause a fundamental change in the character of Canyonlands recommended wilderness
- Major: Degree of nonconforming use is major in area and/or long-term in duration, and would cause a fundamental change in the character of Canyonlands recommended wilderness

Duration:

- Short-term: lasting a day to a few weeks
- Intermediate-term: lasting a few weeks to a few years
- Long-term: lasting several years to permanently

4.2.8.3 Alternative Comparison

4.2.8.3.1 Alternatives A and B (Vehicle Access All Year, Part Year, by Permit System)

Direct and Indirect Effects

Under both of these alternatives, the jeep road would remain in its current location, within the non-wilderness corridor defined in the Canyonlands wilderness recommendation. Neither of these alternatives would establish nonconforming structures or uses within recommended wilderness. Vehicles that could be seen or heard from some areas within recommended wilderness would cause minor auditory and visual impacts. Overall effects of both alternatives on wilderness would be considered negligible.

Cumulative Effects

Most of the Needles district (over 100,000 of 120,000+ acres) and Canyonlands National Park (over 250,000 of 330,000+ acres) is recommended for wilderness designation. On BLM public land adjacent or near the Needles district, over 40,000 additional acres are classified as wilderness study areas. Use and management of these areas generally maintains their wilderness characteristics. The cumulative impact on wilderness characteristics of management of the park and nearby BLM lands, plus project-specific impacts of alternative A or B, would be considered moderate and beneficial.

Conclusion

Alternatives A and B would have negligible effect, continuing long term, on wilderness.

Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the parks's general management plan or other relevant NPS planning documents, alternatives A and B would not cause impairment of the park's resources or values.

4.2.8.3.2 Alternative C (Road Realignment)

Direct and Indirect Effects

This alternative would relocate portions of the road to avoid the stream channel and riparian area. Some parts of these relocated segments would extend beyond the approximately 300-foot-wide non-wilderness corridor, into areas recommended for wilderness. The wilderness recommendation, however, describes this corridor width as approximate, and allows for some variation. The length of relocated road that would extend beyond the current 300-foot road corridor, which is based on the existing road location, is estimated at 1 to 1.8 miles. This would affect an estimated 36 to 65 acres of recommended wilderness initially. Overall lengths of the existing and relocated road sections would be approximately the same, and the abandoned road sections in the riparian area would eventually be obscured by the effects of streamflow and returning vegetation, so that there would be no net long-term reduction in total acreage with wilderness characteristics (i.e., the location of the non-wilderness corridor would be shifted somewhat, but the acreage would remain about the same). This would be considered a moderate impact. Effects of sight and sound of vehicles within some areas of recommended wilderness would be similar to those of alternatives A and B.

Cumulative Effects

Past, present and reasonably foreseeable future effects on Canyonlands National Park and nearby BLM lands, outside the project-specific effects of alternative C, would be as described under alternatives A and B. Including the project-specific impact of alternative C, the cumulative impact on wilderness characteristics of management of the park and nearby BLM lands would be considered moderate and beneficial.

Conclusion

Alternative C would have moderate impact on wilderness.

Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the parks's general management plan or other relevant NPS planning documents, alternative C would not cause impairment of the park's resources or values.

4.2.8.3.3 Alternative D (Vehicles Prohibited All Year)

Direct and Indirect Effects

This alternative would prohibit vehicle use on the Peekaboo to Angel Arch section of Salt Creek

road. No nonconforming uses or structures would be established within recommended wilderness. Vehicles would not be audible or visible frorn nearby areas of recommended wildemess. Vehicle tracks in the streambed or riparian area would be obscured by the effects of streamflow and returning vegetation within a few years. These effects would be considered minor and beneficial to wilderness.

Cumulative Effects

Past, present and reasonably foreseeable future effects on Canyonlands National Park and nearby BLM lands, outside the project-specific effects of alternative C, would be as described under alternatives A and B. Including the project-specific impact of alternative D, the cumulative impact on wilderness characteristics of management of the park and nearby BLM lands would be considered moderate and beneficial.

Conclusion

Alternative D would have rninor and beneficial effects on wilderness.

Because there would be no rnajor adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation of Canyonlands National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the parks's general management plan or other relevant NPS planning documents, alternative D would not cause impairment of the park's resources or values.

5. CONSULTATION AND COORDINATION

Agencies and Organizations

U.S. Fish and Wildlife Service
Bureau of Land Management
Utah State Historic Preservation Office
U.S. Department of the Interior, Office of the Solicitor
U.S. Geological Survey
Utah Department of Environmental Quality, Division of Water Quality

Native American Groups

Navajo Nation
Hopi
Paiute Tribe Of Utah
Southern Ute
Ute Mountain Ute
White Mesa Ute
Northern Ute

Southern Pueblos:
- Zuni
- Acomita
- Isleta
- Laguna
- Santa Ana Pueblo
- Santo Domingo
- Cochiti
- Jemez
- Sandia Pueblo
- San Felipe
- Zia Pueblo

Northern Pueblos:
- Nambe Pueblo
- Pojoaque Pueblo
- San Juan Pueblo
- Tesuque Pueblo
- Picuris Pueblo
- San Ildefonso Pueblo
- Santa Clara
- Taos Pueblo

Other Pueblo Agencies:
- All Indian Pueblo Council
- Eight Northern Indian Pueblo, Inc.
- Five Sandoval Indian Pueblo, Inc.
- Southern Pueblos Governors Council

Preparers and Consultants

National Park Service

David Wood, Planner, Southeast Utah Group
Bruce Rodgers, Chief of Resource Management, Southeast Utah Group
Eric Brunnemann, Archeologist, Southeast Utah Group
Charles Schelz, Biologist, Southeast Utah Group
Jerry Banta, Superintendent, Southeast Utah Group
Phil Brueck, Deputy Superintendent, Southeast Utah Group
Wayne Nielsen, Engineer, Southeast Utah Group
Paul Henderson, Chief of Interpretation, Southeast Utah Group
Gery Wakefield, Geographic Information Systems Specialist, Southeast Utah Group
William Sloan, Biological Technician, Southeast Utah Group
Emily Donald, Archeologist, Intermountain Support Office, Santa Fe
Heather Atherton, Archeologist, Intermountain Support Office, Santa Fe
Richard Inglis, Hydrologist, NPS Water Resources Division
Gregory Eckert, Restoration Ecologist, NPS Biological Resources Management Division
Ron Hiebert, Biologist, NPS Cooperative Ecosystem Studies Unit, Northern Arizona University
Albert Hendricks, Superintendent, Capitol Reef National Park
Tom Clark, Chief of Resource Management, Capitol Reef National Park

U.S. Geological Survey

Tim Graham, Ecologist, USGS/BRD
Robert H. Webb, Geologist, USGS
David J. Mattson, Research Wildlife Biologist, USGS/BRD
Charles Drost, Biologist, USGS/BRD

Other Agencies and Organizations

Abe Springer, Geologist, Northern Arizona University
James Mead, Paleontologist, Northern Arizona University
Steven Burr, Director, Institute for Outdoor Recreation and Tourism, Utah State University
Steve Carothers, Ecologist, SWCA Inc.
Wayne Elmore, BLM, Team Leader, National Riparian Service Team
Janice Staats, Forest Service, Hydrologist, National Riparian Service Team
Don Prichard, Riparian-Wetlands Specialist, National Science and Technology Center

6. COMPLIANCE WITH FEDERAL AND STATE LAWS AND REGULATIONS

The following laws and associated regulations provided direction for the design of project altematives, the analysis of impacts, and the formulation of mitigation measures.

National Park Service Organic Act (16 USC 1 et seq. [1988], Aug. 25, 1916).

The 1916 National Park Service Organic Act is the core of park service authority and the definitive statement of the purposes of the parks and of the National Park Service mission. The act establishes the purpose of national parks:

> . . . to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

National Environmental Policy Act of 1969 (42 USC 4321–4370).

The purposes of NEPA include encouraging "harmony between [humans] and their environment and promote efforts which will prevent or eliminate damage to the environment...and stimulate the health and welfare of [humanity]." The purposes of NEPA are accomplished by evaluating the effects of federal actions. The results of these evaluations are presented to the public, federal agencies, and public officials in document format (e.g., environmental assessments and environmental impact statements) for consideration prior to taking official action or making official decisions. Implementing regulations for NEPA are contained in 40 CFR 1500–1515. This document is prepared to comply with NEPA..

Clean Water Act (33 USC 1251-1376).

The Clean Water Act, passed in 1972 as amendments to the Federal Water Pollution Control Act, and significantly amended in 1977 and 1987, was designed to restore and maintain the integrity of the nation's water.

Clean Air Act (42 USC 7401 et seq., 91 Stat. 685).

The main purpose of this act is to protect and enhance the nation's air quality to promote the public health and welfare. The act establishes specific programs that provide special protection for air resources and air quality related values associated with NPS units. The EPA has been charged with implementing this act. No measurable impacts of the alternatives on air quality are expected, and no additional compliance activities are anticipated relative to the Clean Air Act.

Endangered Species Act of 1973, as amended (ESA) (16 USC 1531–1544).

The purposes of the ESA include providing "a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved." According to the ESA, "all federal departments and agencies shall seek to conserve endangered species and threatened species" and "[e]ach federal agency shall...insure that any action authorized, funded, or carried out by such agency...is not likely to jeopardize the continued existence of any endangered species or threatened species." The USFWS (non-marine species) and the National Marine Fisheries Service (NMFS) (marine species, including anadromous fish and marine mammals) administer the ESA. The effects of any agency action that may affect endangered, threatened, or proposed species must be evaluated in consultation with either the USFWS or NMFS, as appropriate. Implementing regulations which describe procedures for interagency cooperation to determine the effects of actions on endangered, threatened, or proposed species are contained in 50 CFR 402. The NPS has consulted with the USFWS to be consistent with the requirement of Section 7 of the ESA. Impacts to special-concern species have been evaluated in this EA.

National Historic Preservation Act of 1966, as amended (16 USC 470 et seq.).

Congressional policy set forth in NHPA includes preserving "the historical and cultural foundations of the Nation" and preserving irreplaceable examples important to our national heritage to maintain "cultural, educational, aesthetic, inspirational, economic, and energy benefits." NHPA also established the National Register of Historic Places composed of "districts, sites, buildings, structures, and objects significant in American history, architecture, archeology, engineering, and culture." NHPA requires the federal agencies take into account the effects of their actions on properties eligible for or included in the National Register of Historic Places and to coordinate such actions with the State Historic Preservation Offices (SHPO). NHPA also requires federal agencies, in consultation with the SHPO, to locate, inventory, and nominate all properties that appear to qualify for the National Register of Historic Places, including National Historic Landmarks. Further, it requires federal agencies to document those properties (in the case of an adverse effect) and propose alternatives to those actions in accordance with NEPA..

Executive Orders 11988 and 11990, Floodplain Management and Wetland Protection.

These executive orders direct NPS to avoid, to the extent possible, the long- and short-term adverse impacts associated with modifying or occupying floodplains and wetlands. They also require NPS to avoid direct or indirect support of floodplain or wetland development whenever there is a practical alternative.

Executive Order 12898, Environmental Justice in Minority and Low-Income Populations.

This executive order directs federal agencies to assess whether their actions have disproportionately high and adverse human health or environmental effects on minority and low-income populations. This topic was dismissed in this EA; therefore, no additional compliance activities are anticipated under this Executive Order.

State of Utah, Division of Wildlife Resources Policy Number W2AQ-4: State Sensitive Species.

The purpose the Utah Sensitive Species list is to identify those species in the state that are the most vulnerable to population or habitat loss. This list provides land managers, wildlife

managers, and concerned citizens with a brief overview of the conservation status of listed species. The list is intended to stimulate management actions, e.g., development and implementation of a conservation strategy, for listed species. By developing and implementing timely and sufficient conservation measures for Sensitive Species, federal listing of these species under the Endangered Species Act may be precluded.

Executive Order 13186.

This executive order requires Federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to consult with the U.S. Fish and Wildlife Service.

Wilderness Act (16 USC 1121 et seq.)

This act established the National Wilderness Preservation System and direction for its management, and provided for future inventory and Congressional designation of additional wilderness areas.

7. REFERENCES

Agenbroad, L.D., and J. Mead. 1992. Late Quarternary Reconstructions: Salt Creek, Alluvial Geology, Geochronology, Paleohydrology, Paleoenvironments and Archaeology in Salt Creek, Utah. *In* Quarternary Paleoenvironmental Studies of the Colorado Plateau Year IV. Flagstaff, Arizona: Northern Arizona University, Department of Geology, Quartemary Studies Program. Quoted in R.I. Birnie. The Past Environment [of Salt Creek]: Alluvial and Eolian Stratigraphy. *In* Betsy L. Tipps et al. Holocene Archeology Near Squaw Butte, Canyonlands National Park, Utah. Selections from the Division of Cultural Resources, No. 7. Denver, Colorado: National Park Service, Rocky Mountain Region, 1995.

Anderson B.W., A. Higgins, and R.D. Ohmart. 1977. Avian use of saltcedar communities in the Lower Colorado River Valley. USDA Forest Service, General Technical Report RM-43:128-136. Quoted in A.T. Carpenter. Element Stewardship Abstract for *Tamarix*. Davis, Califomia: The Nature Conservancy/University of Califomia, Davis, 1998.

Aukerman, R. and W.T. Springer. 1976. Effects of Recreation on Water Quality in Wildlands. Colorado State University/U.S. Forest Service/Eisenhower Consortium for Westem Environmental Forestry Research Bulletin 2.

Belanger, L., and J. Bedard. 1989. Response of staging greater snow geese to disturbance. Journal of Wildlife Management 53:713-719.

Birnie, R.I. 1995. The Past Environment [of Salt Creek]: Alluvial and Eolian Stratigraphy. *In* Betsy L. Tipps et al. Holocene Archeology Near Squaw Butte, Canyonlands National Park, Utah. Selections from the Division of Cultural Resources, No. 7. Denver, Colorado: National Park Service, Rocky Mountain Region.

Brinson, M.M., B.L. Swift, R.C. Plantico, and J.S. Barclay. 1981. Riparian ecosystems: their ecology and status. U.S. Fish and Wildlife Service, Biological Service Program, FWS/OBS-81/17. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Brinson, M.M. 1977. Decomposition and nutrient exchange of litter in an alluvial swamp forest. Ecology 58:601-609. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Brotherson, J.D., J.G. Carman, and L.A. Szyska. 1984. Stem-diameter age relationships of *Tamarix ramosissima* in central Utah. Journal of Range Management 37:362-364. Quoted in J.M. Di Tomaso. Impact, Biology, and Ecology of Saltcedar (*Tamarix* spp.) in the Southwestern United States. Weed Technology 12:326-336, 1998.

Brown, G.W. 1983. Forestry and water quality. Corvallis: Oregon State University. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Brunnemann, E., E. Donald, and H. Atherton. 2001. An Archeological Inventory of the Salt Creek Road, Salt Creek Archeological District, Needles District of Canyonlands National Park. Santa Fe: National Park Service, Intermountain Support Office.

Budd, W.W., P.L. Cohen, P.R. Saunders, and F.R. Steiner. 1987. Stream corridor management in the Pacific Northwest: I. Determination of stream-corridor widths. Environmental Management 11:5.

Busby, F.E., and G.F. Gifford. 1981. Effects of livestock grazing on infiltration and erosion rates measured on chained and unchained pinyon juniper sites in southeastern Utah. Journal of Range Management 34:400-405.

Carothers, S.W. 2001. An Evaluation of Off-Road Vehicle Use within the Riparian Corridor of Salt Creek, Needles District, Canyonlands National Park, Utah. Unpublished report to NPS. National Park Service, Moab, Utah.

Carpenter, A.T. 1998. Element Stewardship Abstract for *Tamarix*. Davis, California: The Nature Conservancy/University of California, Davis.

Caughlan, L. 1998. Economic Impacts of Tourism on the Economy of Grand County, Utah. Thesis, Department of Agricultural and Resource Economics, Colorado State University, Fort Collins.

Chaney, E., W. Elmore and W.S. Platts. 1990. Livestock Grazing on Western Riparian Areas. U.S. Environmental Protection Agency.

Clifton, C. 1989. Effects of vegetation and land use on channel morphology. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management.

Coats, R.N., R.L. Leonard, and C.R. Goldman. 1976. Nitrogen uptake and release in a forested watershed, Lake Tahoe basin, California. Ecology 57:995-1004. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Connin, S. 1991. Characteristics of successful riparian restoration projects in the Pacific Northwest. EPA Publication 910/9-91-033. Seattle: U.S. Environmental Protection Agency,

Region 10, Water Division.

Cooper, J.R., and J.W. Gilliam. 1987. Phosphorus redistribution from cultivated areas into riparian areas. Soil Science Society of America Journal 51: 1600-1604. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Cooper, J.R., J.W. Gilliam, R.B. Daniels, and W.P. Robarge. 1987. Riparian areas as filters for agriculture sediment. Soil Science Society of America Journal 57:416-420. Quoted in D.M.Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of Interior, Fish and Wildlife Service.

Crins, W.J. 1989. The Tamaricaceae in the southwestern United States. Journal Arnold Arboretum 70:403-425. Quoted in J.M. Di Tomaso. Impact, Biology, and Ecology of Saltcedar (*Tamarix* spp.) in the Southwestern United States. Weed Technology 12:326-336, 1998.

Curtis, P. (Bureau of Land Management/Monticello Office). 2002. Personal communication with D.C. Wood (planner, NPS/Southeast Utah Group).

Dahl, T.E. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C. Jamestown ND: Northern Prairie Wildlife Research Center Home Page.
http://www.npwrc.usgs.gov/resource/othrdata/wetloss/wetloss.htm.

Daw, S. 2001. Avian Population Monitoring in Riparian Habitats Within the Southeast Utah Group of the National Park Service. Unpublished NPS report. National Park Service, Moab, UT.

DeBano, L.F. and L.J. Schmidt. 1989. Interrelationship Between Watershed Condition and Health of Riparian Areas in Southwestern United States. U.S. Forest Service Rocky Mountain Forest and Range Experiment Station/Arizona State University. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management.

Di Tomaso, J. M. 1998. Impact, Biology, and Ecology of Saltcedar (*Tamarix* spp.) in the Southwestern United States. Weed Technology 12:326-336.

Egan, T.B., R.A. Chavez, and B.R. West. 1993. Afton Canyon saltcedar removal first year status report. *In* L. Smith and J. Stephenson, eds. Proceedings, Symposium of Vegetation Management, Hot Desert Rangeland Ecosystems, Phoenix, Arizona. Quoted in J.M. Di Tomaso. Impact, Biology, and Ecology of Saltcedar (*Tamarix* spp.) in the Southwestern United States. Weed Technology 12:326-336, 1998.

Ellis, L.M. 1995. Bird use of saltcedar and cottonwood vegetation in the Middle Rio Grande Valley of New Mexico, USA. Journal of Arid Environments 30:339-349. Quoted in A.T. Carpenter. Element Stewardship Abstract for *Tamarix*. Davis, California: The Nature Conservancy/University of California, Davis, 1998.

Elmore, S., and G.W. Workman. 1978. Campsite impacts on small mammals of the Colorado River, Canyonlands National Park, Utah. M.S. graduate thesis. Utah State University, Logan, Utah. 113 pp.

Elmore, W., J. Staats, and D. Prichard. 2001. Salt Creek Proper Functioning Condition Assessment. National Riparian Service Team, U.S. Bureau of Land Management/U.S. Forest Service.

Elmore, W., and R.L. Beschta. 1987. Riparian areas: perceptions in management. Rangelands 9:260-265.

Engel-Wilson, R.W., and R.D. Ohmart. 1978. Floral and attendant faunal changes on the lower Rio Grande between Fort Quitman and Presidio, Texas. Proceedings of the National Symposium for Protection and Management of Floodplain Wetlands. Quoted in A.T. Carpenter. Element Stewardship Abstract for *Tamarix*. Davis, California: The Nature Conservancy/University of California, Davis, 1998.

Federal Interagency Stream Restoration Working Group (15 federal agencies). 1998. Stream Corridor Restoration. Principles, Processes and Practices. Government Printing Office Item No. 0120-A; Supt. of Documents No. A 57.6/2:EN 3/PT.653. ISBN-0-934213-59-3.

Federal Register. 2001. Final Designation of Critical Habitat for the Mexican Spotted Owl. Vol. 66, No. 22. 8530-8553.

Frasier, G.W., and T.N. Johnsen. 1991. Saltcedar (tamarisk): classification, distribution, ecology, and control. *In* L.H. James, J.O. Evans, M.H. Ralphs, and R.D. Child, eds. Noxious Range Weeds. Boulder, Colorado: Westview Press. Quoted in J.M. Di Tomaso. Impact, Biology, and Ecology of Saltcedar (*Tamarix* spp.) in the Southwestern United States. Weed Technology 12:326-336, 1998.

Freddy, D.J., W.M. Bronaugh, and M.C. Fowler. 1986. Response of mule deer to disturbance by persons afoot and snowmobiles. Wildlife Society Bulletin 14:63-68.

Gardner, P.A., R. Stevens, and F.P. Howe. 1999. A Handbook of Riparian Restoration and Revegetation for the Conservation of Land Birds in Utah with Emphasis on Habitat Types in Middle and Lower Elevations. Utah Division of Wildlife Resources Publication Number 99-38.

Gdula, E., and M. Gudorf. 1998. Southeast Utah Group Sound Monitoring Program, 1994-1996, Final Report. Unpublished report. National Park Service, Moab, UT.

Gebhardt, K.A., C. Bohn, S. Jensen, and W.S. Platts. 1989. Use of Hydrology in Riparian Classification. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management.

Gibbs, J.P. 1998. Amphibian Movements in Response to Forest Edges, Roads, and Streambeds in Southern New England. Journal of Wildlife Management 62(2):584-589.

Gifford, G.F. 1985. Cover allocation in rangeland watershed management (a review). Pages 23-31 *in* E.B. Jones and T.J. Ward, editors. Watershed management in the eighties. Proceedings of a symposium by the Committee on Watershed Management of the Irrigation and Drainage Division of the American Society of Civil Engineers and American Society of Civil Engineers Convention. New York: American Society of Civil Engineers.

Goldman, C.R. and A.J. Home. 1983. Limnology. New York: McGraw-Hill Book Company.

Graham, T. (ecologist, U.S. Geological Survey). 2001. Personal communication with D.C. Wood (planner, NPS/Southeast Utah Group).

Graham, T. 2001. Unpublished preliminary report to NPS. USGS Biological Resources Division. Moab, Utah.

Green, D.M., and J. B. Kauffman. 1989. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management.

Hammitt, W.E., and D.N. Cole. 1987. Wildland Recreation: Ecology and Management. New York: John Wiley and Sons.

Hansen, W.R., and K. Kiser. 1988. High Clark Draw rehabilitation: a "story of success." Pages 255-266 *in* Erosion control: stay in tune. Proceedings of Conference XIX, International Erosion Control Association, Steamboat Springs, Colorado.

Hedman, E.R., and W.R. Osterkamp. 1982. Streamflow Characteristics Related to Channel Geometry of Streams in Western United States. Water-Supply Paper 2193. U.S. Department of Interior, Geological Survey.

Heede, B.H., and L.F. DeBano. 1984. Gully rehabilitation—a three-stage process in a sodic soil. Soil Science Society of America Journal 48:1416-1422.

Hereford, R. 2000. Recent Alluvial History of the Southern Colorado Plateau. On Worldwide Web at http://climchange.cr.usgs.gov/info/sw/scpalluvial. Flagstaff, AZ: U.S. Geological Survey.

Hindley, E.C., J.E Bowns, E.R. Sherick, P.Curtis, and J. Forest. 2000. A Photographic History of Vegetation and Stream Channel Changes in San Juan County, Utah. San Juan County/Utah State University Extension.

Holmes, T.L., R.L. Knight, L. Stegall, and G.R. Craig. 1993. Responses of wintering grassland raptors to human disturbance. Wildlife Society Bulletin 21:461-468.

Homback, K. 1990. Money Generation Model. Denver: National Park Service, Statistical Office.

Horton, J.S. 1977. The development and perpetuation of the permanent tamarisk type in the phreatophyte zone of the Southwest. *In* R.R. Johnson and D.A. Jones. 1977. Importance, preservation, and management of riparian habitat: a symposium. USDA Forest Service General Technical Report RM-43. Fort Collins, Colorado: Rocky Mountain Forest and Range Experiment Station.

Hunter, W.C., R.C. Ohmart, and B.W. Anderson. 1988. Use of exotic saltcedar (*Tamarix chinensis*) by birds in arid riparian systems. Condor 90:11-23. Quoted in A.T. Carpenter. Element Stewardship Abstract for *Tamarix*. Davis, California: The Nature Conservancy/University of California, Davis, 1998.

Irvine, J.R. and N.E. West. 1979. Riparian tree species distribution and succession along the lower Escalante River, Utah. The Southwestern Naturalist 24(2): 331-346.

Inglis, R. 2001. Trip Report, Salt Creek, Canyonlands National Park. Unpublished correspondence, National Park Service, Water Resources Division.

Jacobs, T.C., and J.W. Gilliam. 1985. Riparian losses of nitrate from agricultural drainage waters. Journal of Environmental Quality 14:472-478. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Kasprzyk, M.J. and G.L. Bryant. 1989. Results of biological investigations from the lower Virgin River vegetation management study. Boulder City, Nevada: U.S. Bureau of Reclamation. Quoted in A.T. Carpenter. Element Stewardship Abstract for *Tamarix*. Davis, California: The Nature Conservancy/University of California, Davis 1998.

Knight, R.L. and D.N. Cole. 1991. Effects of recreational activity on wildlife in wildlands. Transactions of the North American Wildlife and Natural Resources Conference 56:238-247.

Knopf, F.L., R.R. Johnson, T. Rich, F.B. Samson, and R.C. Szaro. 1988. Conservation of Riparian Ecosystems in the United States. Wilson Bulletin 100(2): 272-284. Quoted in P.A. Gardner et al. A Handbook of Riparian Restoration and Revegetation for the Conservation of Land Birds in Utah with Emphasis on Habitat Types in Middle and Lower Elevations. Utah Division of Wildlife Resources Publication Number 99-38. Salt Lake City: Utah Division of Wildlife Resources, 1999.

Korte, N., and P. Kearl. 1993. Should restoration of small western watersheds be public policy in the United States? Environmental Management 17:6.

Krueper, D.J. 1992. Effects of Land Use Practices on Western Riparian Ecosystems. *In* D.M. Finch and P.W. Stangel (eds.). Status and Management of Neotropical Migratory Birds. U.S. Forest Service General Technical Report RM-229. Quoted in P.A. Gardner et al. A Handbook of Riparian Restoration and Revegetation for the Conservation of Land Birds in Utah with Emphasis on Habitat Types in Middle and Lower Elevations. Utah Division of Wildlife Resources Publication Number 99-38. Salt Lake City: Utah Division of Wildlife Resources, 1999.

Kundt, J.F., T. Hall, V. D. Stiles, S. Funderburk, and D. McDonald. 1988. Streamside forests: the vital, beneficial resource. College Park, Maryland: University of Maryland Cooperative Extension Service/U.S. Fish and Wildlife Service.

Leopold, L B. 1994. A View of the River. Cambridge, MA: Harvard University Press.

Li, R., and H.W. Shen. 1973. Effect of tall vegetation and flow on sediment. Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers 99:793-814. Quoted

in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Littlejohn, M. 1990. Visitor Services Project: Canyonlands National Park. Moscow, Idaho: University of Idaho Cooperative Park Studies Unit.

Logan, B., and B. Clinch. 1991. Montana forestry best management practices: forest stewardship guidelines for water quality. Missoula, Montana: Montana Departrnent of State Lands, Service Forestry Bureau.

Lovich, J.E., T.B. Egan, and R.C. de Gouvenain. 1994. Tamarisk control on public lands in the desert of Southern California: two case studies. Proceedings, California Weed Conferende 46: 166-167. Quoted in J.M. Di Tomaso. Impact, Biology, and Ecology of Saltcedar (*Tamarix* spp.) in the Southwestern United States. Weed Technology 12:326-336, 1998.

Lowrance, R., J.K. Sharpe, and J.M. Sheridan. 1986. Long-term sediment deposition in the riparian zone of a coastal plain watershed. Journal of Soil and Water Conservation 41(4):266-271. Quoted in L.F. DeBano and L.J. Schmidt. Interrelationship Between Watershed Condition and Health of Riparian Areas in Southwestern United States. U.S. Forest Service Rocky Mountain Forest and Range Experiment Station/Arizona State University. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Lowrance , R.R., R.L. Todd, and L.E. Asmussen. 1984. Nutrient cycling in an agricultural watershed I: phreatic movement. Journal of Environmental Quality 13:22-27. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experirnent Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Marlow, C.B., K. Olson-Rutz, and J. Atchley. 1989. Response of a southwest Montana riparian system to four grazing management alternatives. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management.

Martin, L. 2001. Drinking Water Source Protection Plan, Canyonlands National Park. National Park Service, Water Resources Division.

Martin, M. 1993. Trip report for travel to Canyonlands National Park for flood reconnaissance. Unpublished correspondence, National Park Service, Water Resources Division.

Mason, L.W., and J.L. Johnson. 1999. The Tonto National Forest Stream Assessment Method. *In* Riparian Ecosystem Restoration in the Gila River Basin: Opportunities and Constraints, workshop proceedings. University of Arizona Water Resources Research Center Issue Paper #21. Tucson: University of Arizona. On Worldwide Web at www.ag.arizona.edu/AZWATER/pubs/proceedings.html .

Mattson, D.J. 2001. Comments on ecological effects of the four-wheel-drive route in Salt Creek,

Canyonlands National Park, Utah. Unpublished report to NPS. National Park Service. Moab, Utah. 15 pp.

McCallister, D.L., and T.J. Logan. 1978. Phosphate adsorption-desorption characteristics of soils and bottom sediments in the Moumee River Basin of Ohil. Journal of Environmental Quality 7:87-92. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

McCammon, B., J. Rector, and K. Gebhardt. 1998. A framework for analyzing the hydrologic condition of watersheds. BLM Technical Note 405, Report Number BLM/RS/ST-98/004+7210. U.S. Forest Service/U.S. Bureau of Land Management.

McGarigal, K., R.G. Anthony, and F.B. Issacs. 1991. Interactions of humans and bald eagles on the Columbia River estuary. Wildlife Monographs 115.

Meehan, W.R., F.J. Swanson, and J.R. Sedell. 1977. Influences of riparian vegetation on aquatic ecosystems with particular reference to salmonid fishes and their food supply. U.S. Forest Service General Technical Report RM-43:137-143. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Mills, G.S., J.B. Dunning, and J.M. Bates. 1991. The relationship between breeding bird density and vegetation volume. Wilson Bulletin, 103(3):468-479.

Mitchell, S., and B. Woodward. 1993. Man's effects on aquatic and riparian organisms in the canyons of Canyonlands and Arches National Parks and Natural Bridges National Monument. Rock Springs, Wyoming: Western Wyoming College.

Neill, W.M. 1985. Tamarisk. Fremontia 12:22-23. Quoted in J.M. Di Tomaso. Impact, Biology, and Ecology of Saltcedar (*Tamarix* spp.) in the Southwestern United States. Weed Technology 12:326-336, 1998.

Nester, R. (road crew supervisor, Canyonlands National Park). 2001. Personal communication with D.C. Wood (planner, NPS/Southeast Utah Group).

NOAA (National Oceanic and Atmospheric Administration). 1973. Isopluvials of precipitation. NOAA Atlas, Volume 2. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service.

NPS (National Park Service). 1974. Wilderness Recommendation, Canyonlands National Park.

----------. 1993-2000. Annual Statistical Abstracts. Denver, Colorado: National Park Service, Socio-Economic Studies Division/Public Use Statistics Office.

----------. 1995. Backcountry Management Plan, Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area. Moab, Utah: Canyonlands National Park.

----------. 1999. Directors Order 12. Washington DC: National Park Service.

----------. 2000. Management Policies 2001. Washington DC: National Park Service.

----------. 2001. Monthly Public Use Report, December. Moab, Utah: National Park Service, Southeast Utah Group.

Ohmart, R.D., and B.W. Anderson. 1982. North American Desert Riparian Ecosystems. *In* G.L. Bender (ed.), Reference Handbook on the Deserts of North America. Westport Connecticut: Greenwood Press. Quoted in P.A. Gardner et al. A Handbook of Riparian Restoration and Revegetation for the Conservation of Land Birds in Utah with Emphasis on Habitat Types in Middle and Lower Elevations. Utah Division of Wildlife Resources Publication Number 99-38. Salt Lake City: Utah Division of Wildlife Resources, 1999.

Papouchis, C.M., F.J. Singer, and W.B. Sloan. 2001. Responses of desert bighorn sheep to increased human recreation. Journal of Wildlife Management 65(3):573-582.

Petryk, S., and G. Bosmajian. 1975. Analysis of flow through vegetation. Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers 101:871-882. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Pistrang, M. J. 1987. An analysis of road construction and cattle grazing impacts on riparian vegetation in Capitol Reef National Park, Torrey, Utah. Unpublished thesis. Duke University, School of Forestry and Environmental Studies.

Platts, W.S., and S. Jensen. 1986. Wetland/Riparian Ecosystems of the Great Basin/ Desert and Montane Region: An Overview. *In* Great Basin / Desert and Montane Regional Wetland Functions, proceedings of a workshop at Logan Utah. National Wetlands Technical Council/University of Massachusetts at Amherst, Environmental Institute.

Platts, W.S., and R.L. Nelson. 1989. Characteristics of Riparian Plant Communities and Streambanks with Respect to Grazing in Northeastern Utah. U.S. Forest Service, Intermountain Research Station. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management.

Prichard, D. (fishery biologist/riparian-wetlands specialist, Bureau of Land Managememt). 2002. Personal communication with D.C. Wood (planner, NPS/Southeast Utah Group).

Prichard, D. 1995. Riparian Area Management: Process for Assessing Proper Functioning Condition. Technical Reference 1737-9. U.S. Department of Interior, Bureau of Land Management.

Prichard, D. 1998. Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. Technical Reference 1737-15. U.S. Department of Interior, Bureau of Land Management.

Reed, P.B. Jr. 1988. National list of plant species that occur in wetlands: Intermountain Region. U.S. Department of Interior, Fish and Wildlife Service.

ReMillard, M.D., L.R. Herbert, G.W. Sandberg, and G.A. Birdwell. 1986. Water Resources Data, Utah, Water Year 1986. Water-Data Report UT-86-1. U.S. Department of Interior, Geological Survey.

Rosgen, D. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

---------. 1998. Field Guide for Stream Classification. Pagosa Springs, CO: Wildland Hydrology Books.

Schelz, C. Long Term Riparian Monitoring in Salt Creek, 2001 Report. Moab, UT: Canyonlands National Park.

Schelz, C., M. Moran and D. Silva. 2001. Total vegetation volume and total breeding bird density in Salt Creek, Needles District, Canyonlands National Park. Unpublished NPS report. National Park Service, Moab, Utah.

Schlosser, I.J., and J.R. Karr. 1981. Water quality in agricultural watersheds: impact of riparian vegetation during base flow. Water Resources Bulletin 17:233-240.

Schrader, T.H. 1977. Selective management of phreatophytes for improved utilization of natural flood-plain resources. Water management for irrigation and drainage. Proceedings, Society of Civil Engineering 2:16-44. Quoted in J.M. Di Tomaso. Impact, Biology, and Ecology of Saltcedar (*Tamarix* spp.) in the Southwestern United States. Weed Technology 12:326-336, 1998.

Shafroth, P.B., J.M. Friedman, and L.S. Ischinger. 1995. Effects of salinity on establishment of *Populus fremontii* (cottonwood), and *Tamarix ramosissima* (saltcedar) in southwestern United States. Great Basin Naturalist 55:58-65.

Springer, A. 2001. Evaluation of the effects of vehicle use within the riparian coridor of Salt Creek in the Needles District of Canyonlands National Park. Unpublished report to NPS. National Park Service, Moab, UT.

Swanson, F.J., S.V. Gregory, J.R. Sedell, and A.G. Campbell. 1982. Land-water interactions: the riparian zone. US-IBP Synthesis Series 14-267-291. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

Swarthout, E. and R. Steidl. 2001. Flush responses of Mexican spotted owls to recreationists. Journal of Wildlife Management. 65(2):312-317.

Tipps, B.L. and N.J. Hewitt. 1989. Cultural Resource Inventory and Testing in the Salt Creek Pocket and Devils Lane Areas, Needles District, Canyonlands National Park, Utah. NPS Cultural Resources Report 411-01-8827.

Tipps, B.L. 1995. Holocene Archeology Near Squaw Butte, Canyonlands National Park, Utah. NPS Cultural Resources Report 411-04-9102.

U.S. Bureau of Land Management (USBLM). 1995. Aerial photographs, Salt Creek area, Canyonlands National Park, San Juan County, UT.

U.S. Fish and Wildlife Service (USFWS). 1995. *Recovery Plan for the Mexican Spotted Owl:* Vol. 1. Albuquerque, New Mexico.

----------. 1997. A System for Mapping Riparian Areas in the Western United States. U.S. Department of Interior, Fish and Wildlife Service, National Wetlands Inventory.

----------. 1998. Endangered Species Consultation Handbook.

----------. 2000. Proposed rule: Proposed designation of critical habitat for the Mexican spotted owl. 65 Federal Register 141: 45340.

U.S. Geological Survey (USGS). 1952. Aerial photographs, Salt Creek area, San Juan County, Utah. U.S. Department of Interior, Geological Survey.

--------. 1953. Aerial photographs, Salt Creek area, San Juan County, Utah. U.S. Department of Interior, Geological Survey.

U.S. Soil Conservation Service (USSCS). 1991. Soil Survey of Canyonlands Area, Utah, Parts of Grand and San Juan Counties. U.S. Department of Agriculture, Soil Conservation Service.

Utah Department of Environmental Quality (DEQ). 2002a. Utah's draft 303(d) list of impaired water bodies. Salt Lake City, Utah: Utah Department of Environmental Quality, Division of Water Quality. On World Wide Web at http://www.deq.state.ut.us/eqwq/2002303d.htm.

Utah Department of Environmental Quality (DEQ). 2002b. Utah Administrative Code, Title R317, Environmental Quality, Water Quality. Salt Lake City: Utah Department of Environmental Quality, Division of Water Quality.

Utah Governor's Office of Planning and Budget. 2002. County Data Profiles, San Juan, Grand, Wayne and Garfield Counties. Salt Lake City: Governor's Office of Planning and Budget, Demographic and Economic Analysis Section. On World Wide Web at http://www.governor.utah.gov/dea/profiles/cp/cp2.htm.

Utah Office of Planning and Budget, Utah Department of Community and Economic Development, and University of Utah Bureau of Economic and Business Research. 1992. EDA Tourism Study. Salt Lake City: Utah Office of Planning and Budget.

Vogt, B.J. 2001. The Arroyo Problem in the Southwestern U.S. On Worldwide Web at http://www2.nau.edu/~luhna/Change/arroyos1.htm. Flagstaff, AZ: Northern Arizona University, Land Use History of North America/Colorado Plateau.

Webb, R.H. 2001. Salt Creek: Some preliminary notes on the effect of roads on a perennial stream. Unpublished report to the NPS. National Park Service, Moab, Utah.

Webb, R.H., S. S. Smith, and V.A.S. McCord. 1991. Historic Channel Change of Kanab Creek, Southern Utah and Northern Arizona. Grand Canyon, AZ: Grand Canyon Natural History Association.

Weeks, E.E., H.L. Weaver, C.S. Campbell, and B.D. Tanner. 1987. Water use by saltcedar and by replacement vegetation in the Pecos River floodplain between Acme and Artesia, New Mexico. Washington, D.C.: U.S. Geological Survey Professional Paper 491-G. Quoted in J.M. Di Tomaso. Impact, Biology, and Ecology of Saltcedar (*Tamarix* spp.) in the Southwestern United States. Weed Technology 12:326-336, 1998.

Welsch, D.J. 1991. Riparian forest buffers: function and design for protection and enhancement of water resources. Publication NA-PR-07-91. Radnor, Pennsylvania: U.S. Forest Service, Northeastern Area State and Private Forestry

Whittaker, D. and R.L. Knight. 1998. Understanding wildlife responses to humans. Wildlife Society Bulletin 26:312-317.

Willey, D.W. 1998. Ecology of Mexican Spotted Owls in National Parks on the Colorado Plateau. Ph.D. Dissertation. USGS, Colorado Plateau Field Station, Flagstaff, Arizona.

Winward, A. 2000. Monitoring the vegetation resources in riparian areas. General Technical Report RMRS-GT-47. Ogden, UT: U.S.D.A. Forest Service, Rocky Mountain Research Station. Quoted in W. Elmore, J. Staats and D. Prichard. Salt Creek Proper Functioning Condition Assessment. National Riparian Service Team, U.S. Bureau of Land Management/U.S. Forest Service, 2001.

Wolz, E.R. and D. K. Shiozawa. 1995. Aquatic macroinvertebrates of the Needles District, Canyonlands National Park, Utah (including Lost Canyon, Salt Creek, Big Spring Canyon, and Squaw Canyon). Provo, Utah: Brigham Young University.

Yarbro, L.A. 1979. Phosphorus cycling in the Creeping Swamp floodplain ecosystem and exports from the Creeping Swamp watershed. Doctoral dissertation. Chapel Hill: University of North Carolina. Quoted in D.M. Green and J. B. Kauffman. Nutrient Cycling at the Land-Water Interface: the Importance of the Riparian Zone. Oregon State University Department of Rangeland Resources, Oregon Agricultural Experiment Station Technical Paper No. 8724. *In* Practical Approaches to Riparian Resource Management: An Educational Workshop. Billings, Montana: U.S. Bureau of Land Management, 1989.

APPENDIX 1. SALT CREEK WATER QUALITY

Chemical/Physical Parameters

Park Water Quality Monitoring Results

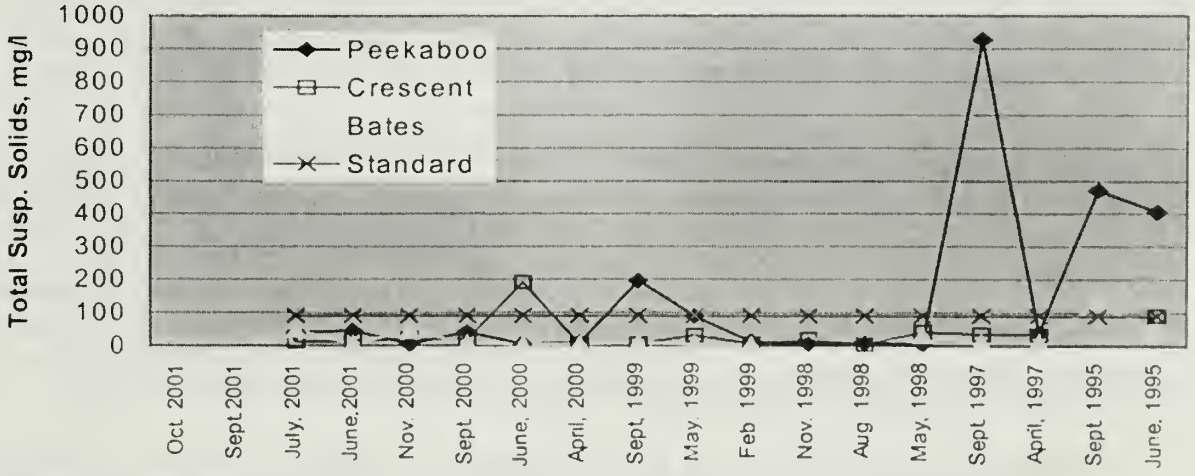
The park has monitored three sites in Salt Creek for water quality since 1995. These sites were sampled two to four times per year until 2001, then twelve times per year since 2001, for physical and chemical characteristics:

- Peekaboo Spring, in the section still travelled by vehicles,
- a pool near Crescent Arch, in the section where vehicle travel ceased in 1998, and
- a pool at the former Bates Wilson campsite, where vehicle travel ceased in the 1970s.

To minimize the influence of temporary increases in sediment load after flash floods, no samples are taken until at least two days after rainstorms.

Total suspended solids and turbidity. Total suspended solids (TSS) generally consist of sediment particles, organic detritus, and plankton. Turbidity, a measure of light penetration, increases with suspended-solids concentration. Soil erosion from a variety of causes probably plays a part when levels for these parameters are elevated. The highest levels for both of these parameters were recorded at the Peekaboo site.

Figure 10. Total Suspended Solids samples, Salt Creek sites.

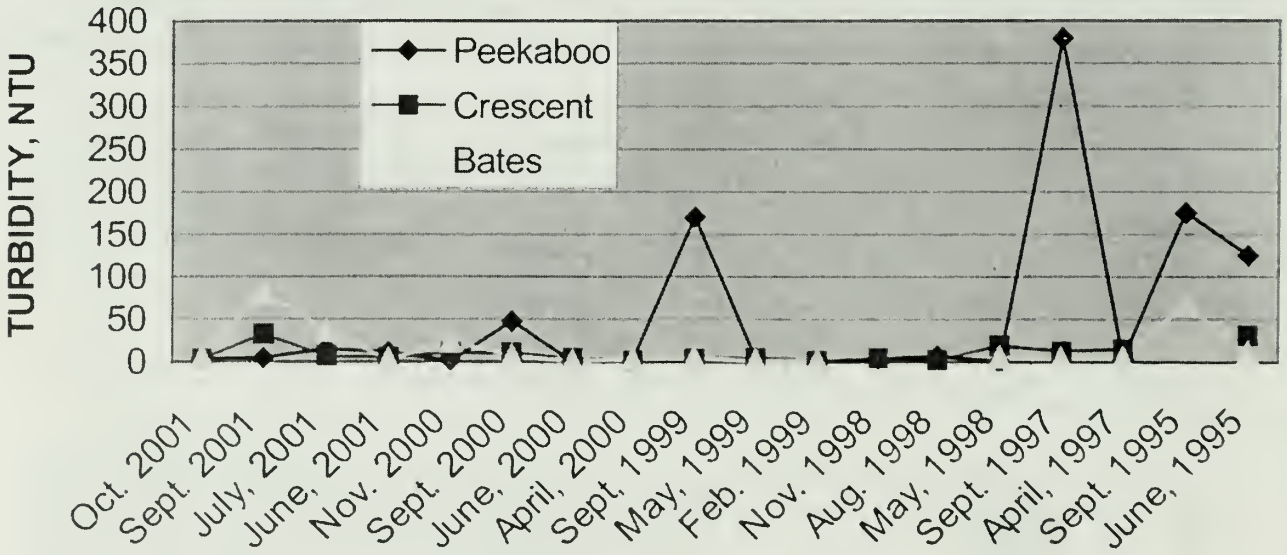


Utah regulations classify total suspended solids as a pollution indicator, but not a state water quality standard subject to violation; exceedences of the TSS level of 90 milligrams/liter suggest

the need for further investigation (Utah DEQ 2002b). TSS levels for non-vehicle samples (Crescent Arch after June 1998 and former Bates Wilson campsite) ranged from 4 to 192 mg/l; levels for vehicle samples (Crescent before June 1998 and Peekaboo) ranged from 4 to 926 mg/l (Figure 10). The frequency of exceedences of the TSS indicator was higher at the Peekaboo site, where vehicle travel has been permitted throughout the monitoring period. Peekaboo had three samples, or 19 percent of the samples, with levels two to over four times higher than the other sites. Frequency of TSS sample exceedences by site was as follows:

- Peekaboo: 25 percent of samples exceeded 90 milligrams/liter
- Crescent with road open: 25 percent of samples exceeded 90 milligrams/liter
- Crescent with road closed: 9 percent of samples exceeded 90 milligrams/liter
- Bates Wilson: 7 percent of samples exceeded 90 milligrams/liter
- Frequency of events when vehicle sites (Peekaboo and Crescent with road open) exceeded indicator level but non-vehicle sites (Crescent with road closed and Bates) didn't: 19 percent
- Frequency of events when non-vehicle sites exceeded indicator level but vehicle sites didn't: none

Figure 11. Turbidity samples, Salt Creek sites.

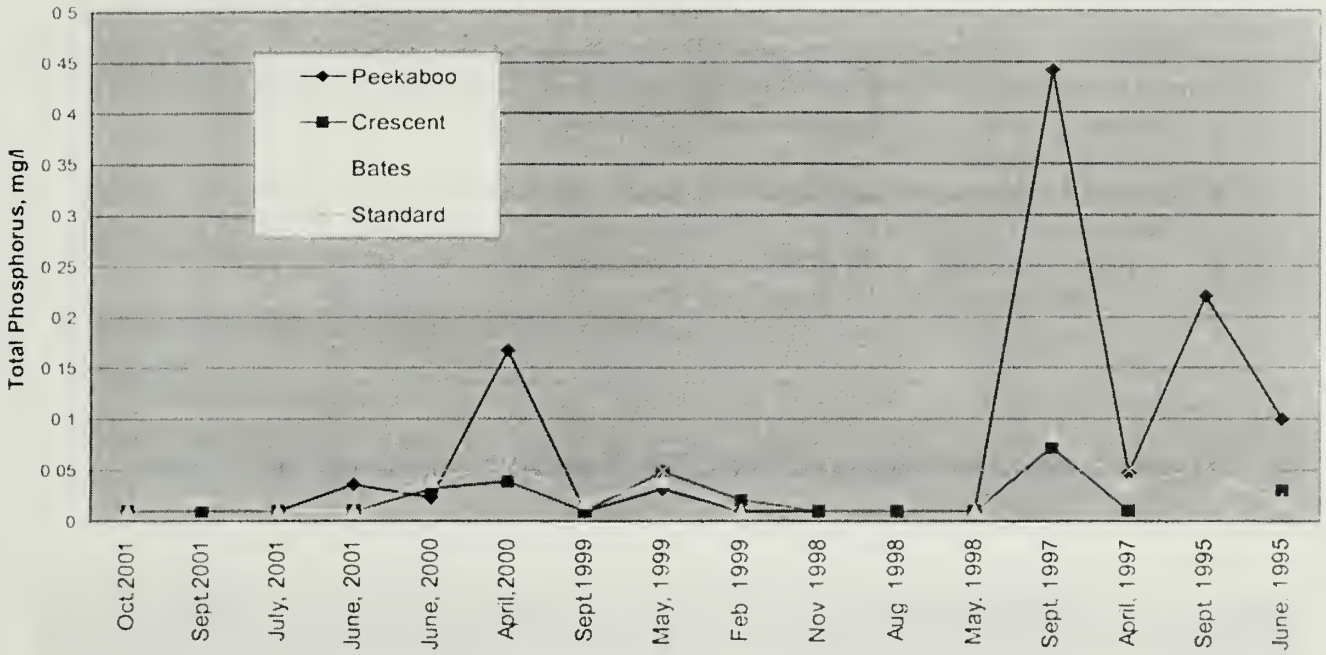


Increase in turbidity compared to background levels is a Utah state water quality standard for use classes 2 and 3, recreation/esthetics and aquatic life (Utah DEQ 2002). Turbidity levels for non-vehicle samples (Crescent Arch after June 1998 and former Bates Wilson campsite) ranged from less than 1 to 82 mg/l; levels for vehicle samples ranged from about 1 to 379 mg/l (Figure 11). Using the Bates Wilson site on a given sample date as the background level, several samples at the Peekaboo site appear to have substantially exceeded the change standard (an increase of 10 standard units above background). Peekaboo had four samples, or 22 percent of the samples, with levels from two to four times as high as any recorded at the other sites.

Phosphorus. Elevated phosphorus levels may result from eroded soil particles, human or animal wastes, detergents, or low levels of dissolved oxygen (Goldman and Horne 1983, Dunn and Leopold 1978, Hammit and Cole 1987). Recreational use at the Peekaboo campsite (overnight camping, a vault toilet, erosion resulting from vehicle and foot traffic) may play a role in

the phosphorus exceedences at this sampling site.

Figure 12. Total Phosphorus samples, Salt Creek sites.



Utah regulations classify total phosphorus as a pollution indicator, but not a state water quality standard subject to violation; exceedences of the phosphorus level of 0.05 milligrams/liter, and a mean of all samples above 0.06 milligrams/liter, suggest the need for further investigation (Utah DEQ 2002b). Sample levels for non-vehicle sites (Crescent Arch after June 1998 and the former Bates Wilson campsite) ranged from 0.01 to to 0.08 mg/l; levels for vehicle samples (Crescent Arch before June 1998 and Peekaboo) ranged from 0.01 to 0.44 mg/l (Figure 12). Peekaboo had four samples that were two to five times as high as the highest samples from the other sites; three of these, or 19 percent of the samples, occurred on sample dates when the other sites were below the indicator level. The other sites each had a single phosphorus exceedence. Frequency of phosphorus exceedences by site was as follows:

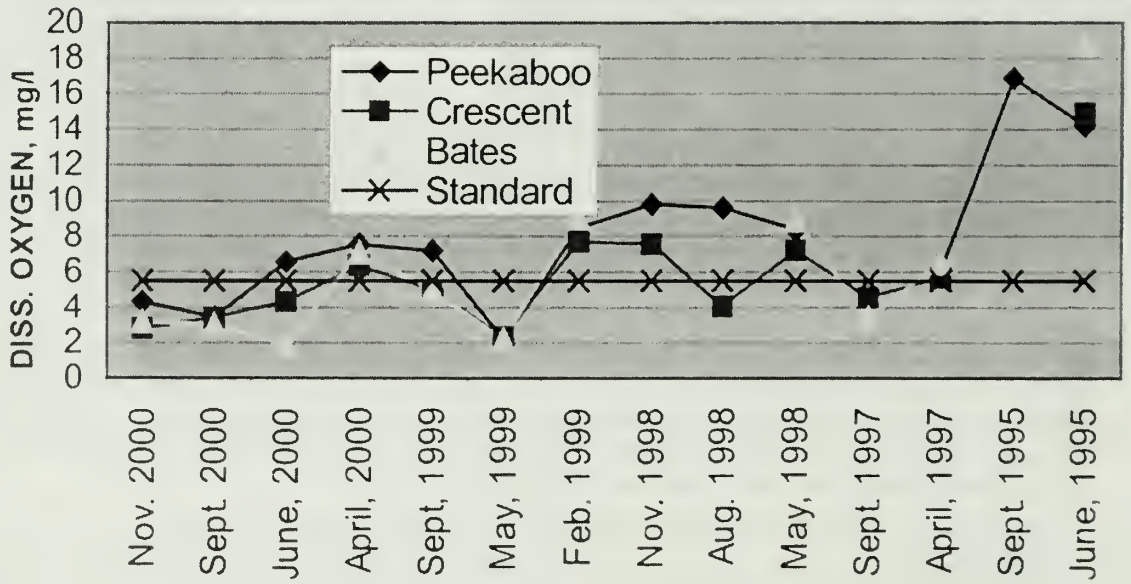
- Peekaboo: 25 percent of samples exceeded 0.05 milligrams/liter; mean of all samples was 0.09 mg/l
- Crescent with road open: 25 percent
- Crescent with road closed: none
- Bates Wilson: 7 percent
- Frequency of events when vehicle sites (Peekaboo and Crescent with road open) exceeded indicator level but non-vehicle sites didn't: 13 percent
- Frequency of events when non-vehicle sites exceeded indicator level but vehicle sites didn't. none

Dissolved oxygen is important to aquatic life as well as the esthetic qualities of water. It is affected by water temperature, aeration from turbulent mixing, decomposing organic material, and other factors.

Utah state regulations set dissolved oxygen standards for use class 3, aquatic life (Utah DEQ 2002b). Sample levels for non-vehicle samples (Crescent Arch after June 1998 and former Bates Wilson campsite) ranged from 1.86 to 18.8 mg/l; levels for vehicle samples (Crescent Arch before June 1998 and Peekaboo) ranged from 2.2 to 16.9 mg/l (Figure 13). The samples from non-vehicle sites had higher frequencies of violations (54 percent for Bates Wilson campsite and 67 percent for Crescent Arch after June 1998) than samples from vehicle sites (23 percent for Peekaboo and 25 percent for Crescent Arch before June 1998). Frequency of dissolved oxygen sample violations by site was as follows:

- Peekaboo: 23 percent of samples violated standards
- Crescent with road open: 25 percent
- Crescent with road closed: 67 percent
- Bates Wilson: 54 percent
- Frequency of events when vehicle sites (Peekaboo and Crescent with road open) violated standards but non-vehicle sites didn't: none
- Frequency of events when non-vehicle sites violated standards but vehicle sites didn't: 25 percent

Figure 13. Dissolved oxygen samples, Salt Creek sites.



Previous Investigations

An earlier investigation of sedimentation in the creek, as affected by vehicle travel, was conducted by Mitchell and Woodward (1993; Table 4). They placed wire screen sediment traps in the stream above and below four vehicle crossings, and above the end of the jeep road, for a 17-day period, and measured the volume of sediment captured. Sand volume captured in cages located below vehicle crossings was approximately 1.6 times higher than sand volume in cages above vehicle crossings and in the non-vehicle reach.

Table 4. Volume of sand captured above and below Salt Creek vehicle crossings and above the end of the jeep road, from Mitchell and Woodward (1992).

Type of Site	Mean Sand Volume (ml)	Standard Error
1. Immediately below jeep road crossings	371	66
2. Immediately above jeep road crossings	223	34
3. Above end of jeep road	217	36

Aquatic Organisms

Park Water Quality Monitoring Results

The park began regularly monitoring aquatic macroinvertebrates in 1997, when vehicles were still travelling the Peekaboo to Angel Arch section. Aquatic macroinvertebrates are collected using a sweep net according to methods developed by Wolz and Shiozawa (1995). Twelve Salt Creek pools are sampled at least twice per year, within the three canyon sections of varying vehicle use (currently traveled by vehicles, vehicle travel ceased in 1998, vehicle travel ceased in the 1970s). Table 5 shows monitoring results. Species richness, or the number of species collected per sample, appears to be higher in the pools without vehicle travel than in the pools where vehicle travel is still permited.

TABLE 5. Aquatic macroinvertebrate species richness (number of species) in Salt Creek monitoring pools, 1997-2000 (Schelz 2001).

	Below Peekaboo (Vehicle travel still permitted)			*Peekaboo – Angel Arch junction (Vehicle travel ceased summer 1998)*							*Above Angel Arch jct. (Vehicle travel ceased by mid-70s)*	
Pool	**01**	**02**	**03**	**05**	**07**	**08**	**09**	**04**	**06**	**10**	**11**	**12**
Road in streambed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No*	No	No	No	No
Species richness	23	22	21	29	26	26	27	29	27	26	29	30

* Road was relocated out of the pool in early 1990s.

Previous Investigations

Wolz and Shiozawa (1995) sampled benthic macroinvertebrates and Salt Creek and three other Needles district canyons (Squaw, Lost, Big Spring) in April and May 1994, when vehicles were still travelling from Peekaboo to Angel Arch. They sampled three sites in Salt Creek, with and without vehicle travel. Results are shown in Table 6. The number of species found at the Angel Arch campsite pool was the highest of all sites in the four canyons sampled. Numbers of species found were considerably higher in the Salt Creek pools, or portions of pools, that were not crossed by the road.

TABLE 6. Aquatic macroinvertebrate species richness (number of species) in Salt Creek pools sampled by Wolz and Shiozawa, April and May 1994.

Pool location	Jeep road in channel?	Number of species
Below Peekaboo		
0.5 km below Peekaboo		
Clear water portion	No	10 (moderate sampling effort)
Turbid water portion	Yes	0 (moderate sampling effort)
		1 (considerable sampling effort)
0.7 km below Peekaboo	Yes	2
Peekaboo – Angel Arch junction		
Former Angel Arch campsite, just downstream from Angel Arch turnoff	No	18

Mitchell and Woodward (1993) investigated aquatic organisms in Salt Creek pools with and without vehicle travel. They found statistically significant differences between types of pools for a few species; data on other species did not indicate significant differences.

APPENDIX 2. SALT CREEK VEGETATION

Park Riparian Monitoring Program

The park established a monitoring program for riparian conditions, including vegetation, on Salt Creek in 1998 (Schelz 2001). Thirteen cross-valley transects are monitored, located between Cave Spring and the Upper Jump in canyon sections with and without vehicle travel. Width of the native riparian vegetation zone adjacent to the streambed in these transects is shown in Table 7. (Mature cottonwoods growing on the terraces above the current level of the stream channel, which established when the stream flowed at that level but are not within the current riparian area, are not included.)

TABLE 7. Width (meters) of native riparian vegetation zone at Salt Creek monitoring transects. Excludes mature cottonwoods on terraces above the current stream channel, which are not within the current riparian area (Schelz 2001).

SECTION	TRANSECT	Jeep Road in Stream Channel?	NATIVE RIPARIAN ZONE WIDTH 1998	NATIVE RIPARIAN ZONE WIDTH 2000	% CHANGE 1998-2000
Peekaboo and below					
	SC-13	Yes	16.23*		
	SC-01	No	16.68	22.40	34%
	SC-02	No	4.62	6.27	36%
Peekaboo – Angel Arch					
	SC-03	No	12.59	13.07	4%
	SC-04	Yes	0.00	0.00	0
	SC-05	Yes	4.63	11.85	155%
	SC-06	No	2.00	5.60	180%
	SC-07	Yes	7.60	12.49	64%
	SC-08	No	11.82	17.51	48%
	SC-09	Yes	1.65	2.30	39%
	SC-10	Yes	0.00	0.00	0
Above Angel Arch turnoff					
	SC-11	No	16.04	13.15	-18%
	SC-12	No	4.50	6.45	43%

* Measured in 1999 only.
Shaded transects have jeep road in streambed.

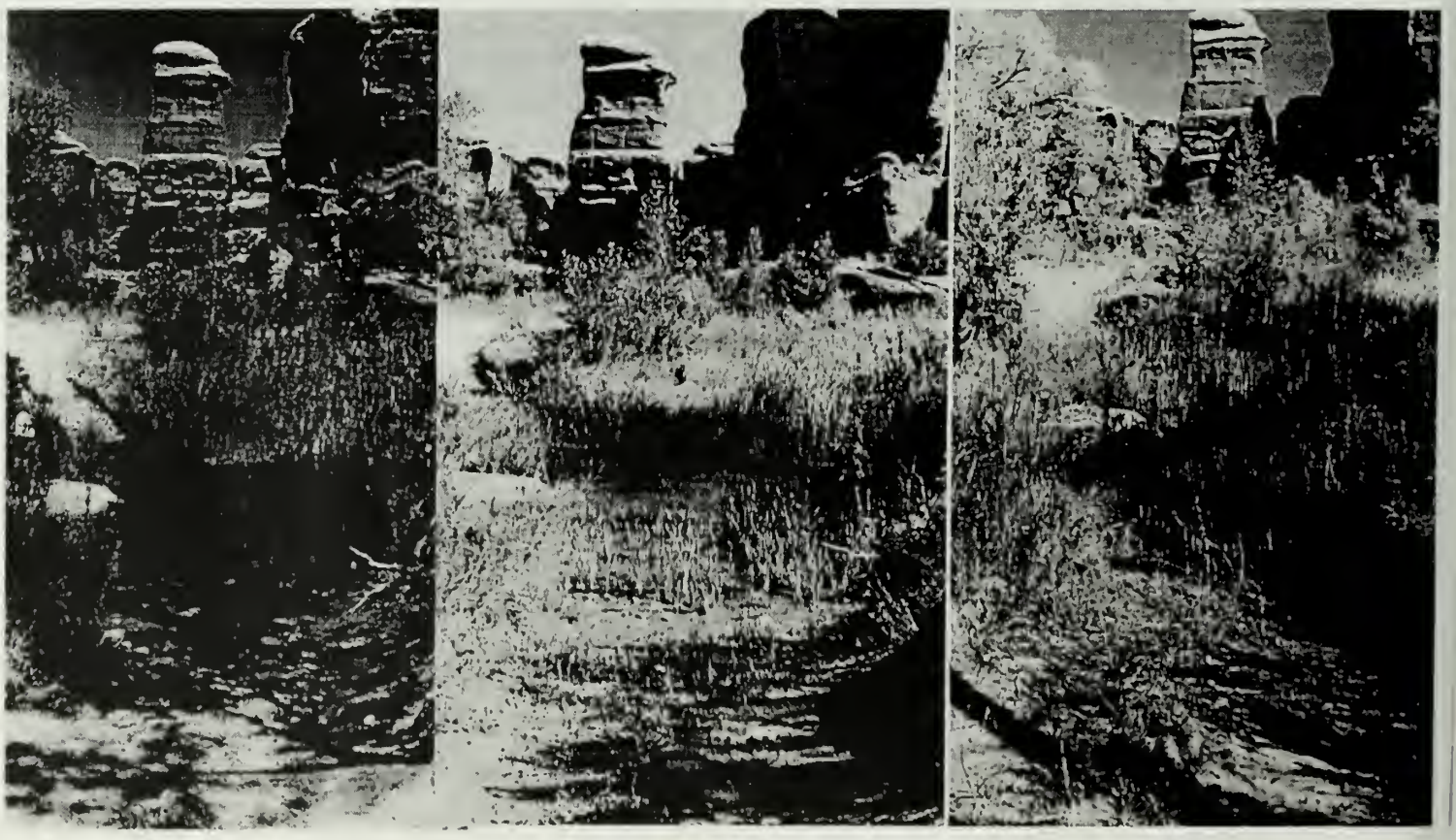
The section below Peekaboo still had vehicle traffic, vehicle traffic on the Peekaboo to Angel Arch section ceased just before the monitoring began, and the section above Angel Arch had not had

vehicle traffic since the 1970s, if ever.

Width of the native riparian vegetation zone has increased at most transects from 1998 to 2000, in sections with and without vehicle traffic, except for three. Two of these transects had no riparian vegetation in 1998 or 2000; the road is in the stream channel in both of these transects, though vehicle travel ceased in this section in 1998. The third transect, section untraveled by vehicles since the 1970s, continues to have a fairly wide riparian vegetation zone, though it decreased somewhat between 1998 and 2000.

The riparian monitoring program also includes over 200 repeat photography points, where photographs of the riparian area are repeated annually from the same locations for comparison. Repeat photography began in 1998, shortly after vehicle travel ceased above Peekaboo but when the effects could still be seen on the stream channel and vegetation. Repeat photographs from 1998 through 2000 are shown in Figures 14-16. In general, riparian vegetation has increased since 1998 in locations with higher water availability (i.e. longer duration surface water or ground water close enough to the surface to support native riparian plants) where vehicles formerly traveled in the stream channel or riparian area.

Figure 14. Salt Creek repeat photographs, 1998-2000.



1998 1999 2000

Figure 15. Permanent Photo-Point SC-66 in 1998.

Figure 16. Permanent Photo-Point SC-66 in 2000.

Previous Investigations

Mitchell and Woodward (1992) compared plant distributions and patterns of abundance in sections of Salt Creek Canyon with and without vehicle travel, near, both above and below, the Angel Arch turnoff. (Vehicles were still travelling as far as the old Bates Wilson campsite, about a half-mile above the Angel Arch turnoff, when the study was conducted. The study area extended about 1.5 miles above and below the Bates Wilson camp.) Mitchell and Woodward sampled during two years, with twice the number of sample plots the second year. They found that the canyon bottom lacking vehicle travel was higher than the canyon bottom with vehicle travel in the following vegetation parameters:

- total plant cover (146 percent to 187 percent higher)
- structural complexity, or plant volume at four heights (0.5 meter, 0.5-1.0 meter, 1.0-3.0 meters, and above 3 meters)
- total tree coverage
- frequency (i.e. number of sample plots observed in) and/or ground coverage of various riparian species, including cottonwoods, willows, rushes, *Clematis ligustifolia*, and *Castilleja linariifolia*.

Tamarisk, generally a riparian species, was found in more plots and had higher ground coverage in the non-vehicle section in the first year of the Mitchell and Woodward study; in the second year, when the number of sample plots was doubled, tamarisk was found in more plots in the vehicle section, and had about the same ground coverage in both sections.

APPENDIX 3. EXCERPTS FROM SALT CREEK FUNCTIONING CONDITION ASSESSMENT

Wayne Elmore, Bureau of Land Management, Janice Staats, Forest Service, Don Prichard, Bureau of Land Management

National Riparian Service Team

Results

Upon receiving the request and agreeing to help the Canyonlands National Park assess the functionality of Salt Creek, we began the process of pulling together and reviewing all the information we could find for Salt Creek. Most of this information was provided to us by specialists at Canyonlands National Park. Our quest for information was also augmented with a report written by Richard Inglis, Hydrologist, Water Operations Branch, WRD, NPS who completed a trip to Salt Creek the week of March 28-30, 2001. This trip also served as a reconnaissance for our trip to assess PFC the week of May 21-25, 2001.

To assist our Team in this assessment we also completed two searches in hopes of acquiring additional information about Salt Creek. One search was for USDI United States Geological Survey (USGS) flow records for Salt Creek. It was our hope these might provide information that would indicate whether Salt Creek would be classified perennial or intermittent. The search did not provide the needed information. However, our on-the-ground observations of moist soils, riparian-wetland vegetation species, and information from the park tells us this stream is intermittent.

The other information search was to identify the aerial photo coverage that existed for Salt Creek, and we found coverage that had been flown in the early 1950's to the late 1990's. The aerial photos used in our assessment were the 1953 photography and the 1995 photography. The 1953 photography was 1:40,000 National High Altitude Program (NHAP) black and white and the 1995 was 1:24,000 BLM natural color.

This photography was used to complete several aspects of our assessment. The natural color 1:24,000 photography was used to help identify Salt Creek's reaches, attributes and process, trend, and complete our PFC checklists. The black and white 1:40,000 photography provide us information relative to condition before the road existed and helped define trend. These photos were viewed using a Topcon mirror-stereo scope.

Our Team defined five reaches from the 1995 aerial photos based on landform, geology, fluvial processes, vegetation changes, and hydrologic changes in Salt Creek. These reaches were fine tuned during our field visits the week of May 21-25, 2002. The five reaches for Salt Creek are:

- Upper Salt Creek drainage down to the Upper Jump on Salt Creek;

- Upper Jump down to the confluence of Angel Arch drainage and Salt Creek;
- Confluence of Angel Arch drainage and Salt Creek down to the confluence of Horse Canyon and Salt Creek;
- Confluence of Horse Canyon and Salt Creek down to the Lower Jump on Salt Creek; and
- the Lower Jump on Salt Creek down to where it enters the Colorado River.

Two reaches, the one above the upper jump and the one below the lower jump, are located outside of the area of concern so we did not do a PFC assessment on them. A quick look at these reaches on the 1995 aerial photos indicated that these areas were in good condition.

Next we began to assess functionality of the three remaining reaches on Salt Creek using the guidelines provided in technical reference (TR) 1737-12, *Using Aerial Photographs to Assess Proper Functioning Condition of Riparian-Wetland Areas* (Prichard et al., 1996). The team then visited the sites on the ground the week of May 21-25, 2001 and finalized a checklist for each reach as per TR 1737-15 (Prichard et al., 1998). Completed checklists can be found in Appendix B.

A. Lower Jump to Horse Canyon

Our Team classified this reach as a C5 stream type (Rosgen 1996). This was determined from both the pre-work and the on the ground survey for the area between Cave Spring and the confluence of Salt Creek and Horse Canyon. This stream type is a sand dominated channel that should be slightly entrenched, meandering, have a riffle/pool channel with a well developed floodplain. Riparian-wetland vegetation has a very high controlling influence on the width:depth ratio and stability of this stream type. Without the right kind and amount of riparian-wetland vegetation, C5 stream types are susceptible to shifts in both lateral and vertical stability. It is the holding power of the roots and above ground biomass that allow sand depositions to be stabilized, building streambanks and floodplains.

Upon completing the checklist for this reach we rated it as functional—at risk with no apparent trend (recent years). While we did find some good aspects, this reach was rated functional—at risk because it lacked the following: sinuosity needed to dissipate energies during high flow events; adequate channel characteristics to allow access to a floodplain to dissipate energies; and the necessary vegetative cover on stream banks to provide protection from erosive forces and dissipate energy during high flows. The Team attributed most of the impacts to the road being in the stream bed. The amount of road crossings and road bed in the channel bottom is impacting the amount of riparian-wetland vegetation and the channel sinuosity. Vehicle wheel action causes plant damage and loosens soil. The road bed then begins to capture the flow by routing water in the vehicle tracks and over time straightens the channel, reducing sinuosity. These changes lead to alteration of the site by widening and deepening the channel. Over time this results in a lower water table and dries out the site. This altered condition is more suitable to the establishment of the less desirable tamarix over other more desirable species such as willow, sedges and rushes.

The presence of tamarix, an introduced species, is beginning to dominate this reach in places, and is a concern to the park. The PFC assessment method does not separate introduced species from

native species but we do rate vegetation species on their ability to stabilize banks, capture sediments, and reduce stream energies. Some introduced species can aid in floodplain development and energy dissipation associated with flow events. On the other hand, the presence of only one species makes a site very vulnerable because a disease, insect infestation, or climatic event could kill all or most of the plants. Species needed to meet the goals of a desired condition are addressed after the stream system is assessed. However, tamarix is not an adequate species for either physical or biotic conditions. Tamarix in sandy soils is rated as a "6" out of 10 for bank stability (Winward 2000). Because this species can totally dominate the site and keep other species from establishing, it is very difficult to improve this rating through the development of diverse vegetation communities.

The Team gave a "no apparent trend" rating to this reach because during the last several years there was no evidence the riparian area had made any additional progress. Analysis of aerial photos between 1953 to 2001 shows an overall strong upward trend on Salt Creek. However, we attribute most of this change to the removal of season-long livestock grazing in the 1970's. We also feel that additional recovery is being kept in check by the presence of the road in Salt Creek. This stream type requires a minimum of 85% riparian-wetland vegetative cover (Winward 2000) (with those plant communities that have root masses capable of withstanding high streamflow events), and we observed an average of less than 60%.

B. Horse Canyon to Angel Arch

Pre-work on the reach between the confluence of Salt Creek and the tributary from Angel Arch downstream to the confluence of Salt Creek and Horse Canyon indicated most of this stream was a C channel type with some mixing of an E channel type. The major difference between a C and E channel type is E channels have a very low width/depth ratio and no point bars. Our site visit confirmed that much of this section of Salt Creek is either a C4 or a C5 channel type with some of it being a E5 channel type (Rosgen 1996). C4 channel types are gravel dominated sites while C5 and E5 channel types are sand dominated sites. Riparian-wetland vegetation has a very high influence on width:depth ratio and stability, and thus functionality for all these stream types.

The team rated this reach as functional-at-risk with an upward trend. There was good evidence of the recruitment of willows, cottonwoods, and herbaceous bank stabilizing species which are a main indicator for trend (PFC Checklist item #6). In places the stream was narrowing and the riparian zone was widening. We observed the reestablishment of riparian vegetation species, sediment filtering, and new bank building occurring in old road crossings. We also observed the impact that occurred this spring by just two vehicles that made the trek up the closed portion of Salt Creek. Road crossings that had begun to recover were set back by just 4 vehicle passes. This reach was rated as functional—at risk because it lacked adequate vegetative cover for bank protection and energy dissipation during high flows. This stream type requires a minimum of 85% riparian-wetland vegetative cover (Winward 2000) (with those plant communities that have root masses capable of withstanding high streamflow events), and we observed an average of 60-70 percent.

C. Angel Arch Tributary to Upper Jump

The reach between the confluence of Salt Creek and the tributary from Angel Arch upstream to the upper jump was rated PFC. This reach was a combination of C4 and E5 channel types. All the items on the PFC checklist were found to be in a working order or non-applicable (N/A). While there was evidence of past impacts from the presence of the road, the riparian area has recovered and will accommodate relatively frequent high flows such as 5-, 10-, and 20-year events.

D. Functional Ratings Summary

An ocular PFC assessment by the team based on the 1953 aerial photos of Salt Creek resulted in rating of nonfunctional in all three reaches. Our best guess is the condition of Salt Creek in 1953 was probably due to the continuous season-long livestock grazing present at this time. When grazing was removed in the 70's this allowed Salt Creek to begin to recover. However, other uses such as recreation can also effect the stability of riparian-wetland areas and must be considered in management plans.

Two of the three reaches were rated as functional—at risk. The major reason was the lack of adequate riparian-wetland vegetation to protect banks and dissipate energy (PFC checklist item #11). This lack of vegetation was the direct result or impact from the presence of the road. Stretches of Salt Creek where the road has been closed are starting to recover. Stretches where the road is still used the riparian-wetland resource continue to be impacted and recovery was much slower.

Completed checklists for each reach are found in the Appendix.

E. Ecological Condition

Riparian vegetation species that were observed by the Team during the survey of Salt Creek are indicators of an early seral community type. The four species of willow, cottonwood, and rush species present establish on disturbed soils. The Team did observe some late seral sedge and rush species but they were primarily individual clumps and had not began to form communities. The incidence of early seral species does not mean that they are not desirable for the functionality of the stream system but it is indicative that the riparian area is still in the early stages of its' evolution. The potential plant community would be more diverse and contain a mix of more sedge and rush species. Appendix D contains a list of the species of vegetation we observed.

Standard Checklist

Name of Riparian-Wetland Area: Salt Creek
Date: May 22, 2001 Segment/Reach ID: Lower Jump to Confluence with Horse Canyon
Miles: Approximately 7 miles
ID Team Observers: Wayne Elmore, Janice Staats, Don Prichard

Yes	No	N/A	HYDROLOGY
✔			1) Floodplain above bankfull is inundated in "relatively frequent" events
		✔	2) Where beaver dams are present they are active and stable
	✔		3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region) Existing road bed has captured the active channel in several places and reduces the stream meander and its ability to dissipate energy. Width/Depth is also effected where the road is in the stream bed. There are 3 states to the channel: 1)channel was never a road and has a characteristic Rosgen C channel shape, 2) the channel used to be a road but isn't anymore and shows vegetation recovery but has a roadbed shape, and 3) the channel is the road and has a roadbed shape.
✔			4) Riparian-wetland area is widening or has achieved potential extent The 1953 photos show much less vegetation then occurs today and provides an easy yes answer. Also, we observed recruitment of woody species on site. There are some "sore spots" where wave action from vehicles going through pools is washing soil from riparian vegetation roots. Rushes are here now and not obvious in 1953 air photos.
✔			5) Upland watershed is not contributing to riparian-wetland degradation We observed no degradation, but there is a missed opportunity to aid floodplain development in Salt Creek from sediment load from Horse Canyon.

Yes	No	N/A	VEGETATION
✔			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery) Willows and cottonwoods have 2 age classes. Herbaceous riparian vegetation is recruiting in places.
✔			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery) Mostly Baltic rush but there is a scattering of other species.
✔			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics A number of FAC wet plants present and some obligate wet plants.
✔			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high-streamflow events
✔			10) Riparian-wetland plants exhibit high vigor Baltic rush and bullrush are very vigorous.
	✔		11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows Less than 60 percent cover and this is a stream type that needs at least 85 percent

		✔	12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)

Yes	No	N/A	EROSION/DEPOSITION
	✔		13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy Over flow channels are present, but not being accessed due to impacts from the road on sinuosity. and not dissipating energy as it should.
✔			14) Point bars are revegetating with riparian-wetland vegetation Point bars that are present are being captured by vegetation. However. there is a lack of point bars which is tied to the answers in item 3 and item 13.
	✔		15) Lateral stream movement is associated with natural sinuosity Lateral stream movement is being controlled by the existing road.
✔			16) System is vertically stable
✔			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

(Revised 1998)

Summary Determination

Functional Rating:

Proper Functioning Condition	_____
Functional–At Risk	___✔___
Nonfunctional	_____
Unknown	_____

Trend for Functional–At Risk:

Upward	_____
Downward	_____
Not Apparent	_✔__ (in recent years)

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes	___
No	_✔__

If yes, what are those factors?

___ Flow regulations	___ Mining activities	___ Upstream channel conditions
___ Channelization	___ Road encroachment	___ Oil field water discharge
___ Augmented flows	___ Other (specify)_____	

Standard Checklist

Name of Riparian-Wetland Area: Salt Creek
Date: May 22-23, 2001 Segment/Reach ID: Confluence of Horse Canyon to Angel Arch tributary
Miles: Approximately 8 miles
ID Team Observers: Wayne Elmore, Janice Staats, Don Prichard

Yes	No	N/A	HYDROLOGY
✔			1) Floodplain above bankfull is inundated in "relatively frequent" events Debris present on floodplain vegetation and sediment deposits indicate yes.
		✔	2) Where beaver dams are present they are active and stable
✔			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region) The majority of the reach is yes. However, there was great variation in the width/depth ratio, especially where the road traveled in the stream bed. The road has impacted 30-40 percent of the streambanks. Some channels we walked were old road beds that are recovering. There are 3 states to the channel: 1)channel was never a road and has a characteristic Rosgen C channel shape, 2) the channel used to be a road but isn't anymore and shows vegetation recovery but has a roadbed shape, and 3) the channel is the road and has a roadbed shape. Much of the channel between Horse Canyon and Peekaboo is roadbed.
✔			4) Riparian-wetland area is widening or has achieved potential extent Willows and colonizers were growing in most road crossings indicating the riparian area is widening. By no means have we achieved potential extent.
✔			5) Upland watershed is not contributing to riparian-wetland degradation

Yes	No	N/A	VEGETATION
✔			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery) We found 4 age classes of cottonwoods, good recruitment of willows, and vigorous clumps of herbaceous vegetation.
✔			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery) Found cottonwood, coyote willow, streambank willow, peach leaf willow, Baltic rush, cattail, bullrush, and possibly panicum.
✔			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics Obligate and FAC wet plants present.
✔			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high-streamflow events Willows/Baltic rush community type present.
✔			10) Riparian-wetland plants exhibit high vigor Especially Baltic rush. It was tall and dark green.

	✔		11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows Vegetative cover is important for this channel type and needs to be 85 percent. We observed 60-70 percent.
		✔	12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery) Live plant root mass (trees, shrubs, and herbaceous) most important to hold this system together.

Yes	No	N/A	EROSION/DEPOSITION
	✔		13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy The road at times is in the overflow channels. Impacts from the road have effected the ability of some of these characteristics to function like they should.
✔			14) Point bars are revegetating with riparian-wetland vegetation Not many classic point bars but those that do exist they are being vegetated right at or near streambanks.
✔			15) Lateral stream movement is associated with natural sinuosity
✔			16) System is vertically stable For the most part yes. However, there is a headcut in an overflow channel in the upper most part of this reach that could effect the last 100 yards. This area is in pretty good shape and would be a shame to lose it.
✔			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

(Revised 1998)

Summary Determination

Functional Rating:

Proper Functioning Condition	_____
Functional–At Risk	___✔___
Nonfunctional	_____
Unknown	_____

Trend for Functional–At Risk:

Upward	_✔___
Downward	_____
Not Apparent	_____

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes	___
No	_✔_

If yes, what are those factors?

___ Flow regulations ___ Mining activities ___ Upstream channel conditions
___ Channelization ___ Road encroachment ___ Oil field water discharge

___ Augmented flows ___ Other (specify)_____

Standard Checklist

Name of Riparian-Wetland Area: Salt Creek
Date: May 23, 2001 Segment/Reach ID: Angel Arch tributary to Upper Jump
Miles: Approximately 4 miles
ID Team Observers: Wayne Elmore, Janice Staats, Don Prichard

Yes	No	N/A	HYDROLOGY
✔			1) Floodplain above bankfull is inundated in "relatively frequent" events Has excellent access to floodplain.
		✔	2) Where beaver dams are present they are active and stable
✔			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region) Very narrow and deep with good sinuosity.
✔			4) Riparian-wetland area is widening or has achieved potential extent Is moving towards achieving potential extent.
✔			5) Upland watershed is not contributing to riparian-wetland degradation

Yes	No	N/A	VEGETATION
✔			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery) Two or ages classes for woody and herbaceous plants.
✔			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery) No question we have diverse composition to maintain this site.
✔			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics Obligate and FAC wet plants present.
✔			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high-streamflow events
✔			10) Riparian-wetland plants exhibit high vigor Very high vigor.
✔			11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows Over 90 percent coverage of banks by the right plants excluding rock outcrop areas.
		✔	12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)

Yes	No	N/A	EROSION/DEPOSITION
✔			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy Overflow channels are being accessed with flows.
✔			14) Point bars are revegetating with riparian-wetland vegetation Where present they are being vegetated.
✔			15) Lateral stream movement is associated with natural sinuosity
✔			16) System is vertically stable No headcuts or downcutting.
✔			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

(Revised 1998)

Summary Determination

Functional Rating:

Proper Functioning Condition __✔____
Functional–At Risk _____
Nonfunctional _____
Unknown _____

Trend for Functional–At Risk:

Upward _____
Downward _____
Not Apparent _____

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No _✔_

If yes, what are those factors?

___ Flow regulations ___ Mining activities ___ Upstream channel conditions
___ Channelization ___ Road encroachment ___ Oil field water discharge
___ Augmented flows ___ Other (specify)_____

Riparian Plant Species and Communities List

	Stability Rating [1]	Wetland Indicator Category [2]
Woody Plants		
Populus fremontii Fremont Cottonwood	6	Facultative Wetland
Populus angustifolia Narrow-leaf cottonwood	6	Facultative
Salix lutea Yellow Willow	6	Obligate
Salix exigua Sandbar or Coyote Willow	6	Obligate
Salix amygdaloides Peachleaf Willow	6	Facultative Wetland
Rushes		
Juncus balticus Baltic Rush	9	Facultative Wetland
Scirpus acutus Hard-stem Bulrush	9	Obligate
Eleocharis species Spike Rush	6	Most are obligates
Sedges		
Carex aquatilis Water Sedge	9	Obligate
Carex nebrascensis Nebraska Sedge	9	Obligate
Typha species Cattail	9	Obligate
Tamarix species Saltcedar	6[3]	Facultative Wetland
Community Types		
Willow/Baltic rush	9-10	
Cottonwood/willow/baltic rush	9-10	
Baltic rush	9	
Baltic rush/bulrush	9-10	
Tamarix	6[3]	

Potential Community Types

Cottonwood/willow--willow/mesic graminoid--sedge/rush complex.

---

[1] Winward, A. 2000. Monitoring the vegetation resources in riparian areas. Gen. Tech. Rep. RMRS-GT-47. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

[2] Reed, P.B. Jr. 1988. National list of plant species that occur in wetlands: Intermountain (Region 8). National Wetlands Inventory. USDI Fish and Wildlife Service.

[3] Personal communication with Dr. Alma Winward.

APPENDIX 4.

1/25/02

NPS R.S. 2477 Preliminary Assessment
San Juan County - Salt Creek Canyon Claim

Executive Summary

The National Park Service (NPS) has reviewed appropriate documents and conducted on-site inspections to assess the validity of San Juan County's Revised Statute (R.S.) 2477 right-of-way claim[1] in Salt Creek Canyon, in the Needles District of Canyonlands National Park. This preliminary assessment is based on readily available factual evidence collected by the NPS and information provided by San Juan County. Based on this evidence, NPS concludes that the claimed route does not meet the general standards for an R.S. 2477 right-of-way. NPS recommends that a formal agency determination be completed, preceded by a general public notification seeking any additional evidence on the claim that may not have been obtained to date, and incorporating any such additional information that may be forthcoming.

I. Background and Overview of Process

A. Basis for Determination: Action in U.S. District Court

In 1998 the U.S. District Court for the State of Utah ruled, in a lawsuit by the Southern Utah Wilderness Alliance[2], that the 1995 Canyonlands Backcountry Management Plan (BMP) violated the NPS Organic Act by failing to close the upper 8.2 miles (above Peekaboo campsite) of the Salt Creek four-wheel-drive route . The jeep route substantially follows the creek bed in the bottom of Salt Creek and had been shown in studies to be adversely impacting the stream and adjacent riparian areas. The court enjoined the NPS from continuing to allow limited use of the area by motorized vehicles. San Juan County did not intervene in the pending litigation.

Intervenors representing four-wheel-drive interests appealed, and on August 15, 2000, the Tenth Circuit Court reversed and remanded the case to the district court for application of different standards of deference, re-examination of the administrative record, and consideration of new NPS

[1] Recodified as 43 U.S.C. § 932 (1938); repealed by the Federal Land Policy and Management Act of 1976, § 706(a), Pub. L. No. 94-579, 90 Stat 2744, 2793 (1976).

[2] Southern Utah Wilderness Alliance v. Dabney, Case No. 2: 95 CV 559 K (D. Utah, 1998).

policy related to determinations of "impairment of park resources or values," the central issue in the case.

The NPS subsequently prohibited motorized travel in Salt Creek above Peekaboo, pending further environmental analysis of the effects of motorized vehicles on resources and values in the canyon. Following the Tenth Circuit ruling, San Juan County, which had thus far not chosen to enter the litigation, notified the NPS that it claimed the Salt Creek route as a county road under RS-2477. The county had previously made such claim in comments submitted during the EA process for the BMP (March 1994). Efforts to reach agreement with the county over the closure were unsuccessful.

Mr. David Bernhardt, on behalf of the Department of the Interior, contacted county officials in the winter of 2001 and advised them that the Department would undertake a close examination of the R.S. 2477 issue and ensure a process for considering the County's claim which would be fair to the interests of all, including San Juan County and the State of Utah.

That examination led the NPS to gather and analyze evidence so that a preliminary assessment of the county's claim could be made. This document summarizes the information gathered to date and the NPS's initial conclusions based upon this information.

B. Collection of Evidence

1. Request for Information

On May 9, 2001, NPS wrote to San Juan County to request any information the county might have relative to the establishment of an RS-2477 right-of-way in Salt Creek Canyon. NPS followed up this letter with an oral request at a meeting with the County Commissioners on June 11, 2001.

2. Document Review

The NPS conducted extensive reviews of various documents and records that might be relevant to whether San Juan County had established an RS-2477 highway in Salt Creek Canyon. These documents and records included historic maps produced by the United States and the State of Utah, aerial photographs, park records and planning documents, publications, and other agencies' records. At the request of NPS, the Bureau of Land Management (BLM) conducted extensive reviews of United States public land records to determine whether the public lands underlying the claimed right-of-way were withdrawn, reserved, or otherwise unavailable for establishment of an R.S. 2477 right-of-way during any periods between 1866 and the establishment of Canyonlands National Park in 1964. The BLM also reviewed official Public Land Survey System (PLSS) records, range improvement project files, and road-related records for relevant information.

3. Field Inspections

NPS conducted field inspections on the claimed right-of-way to look for on-the-ground features

which might indicate road construction or improvement.

4. Interviews and Affidavits

NPS reviewed affidavits from five people provided by San Juan County, including four on past use and/or possible road construction in Salt Creek Canyon. NPS also interviewed a number of people who had been in Salt Creek Canyon prior to the establishment of Canyonlands National Park in 1964, including two of the four people who submitted affidavits on past use and/or possible road construction. NPS also requested interviews with the other two affiants, but each declined.

C. General Standards Applicable to Determinations

R.S. 2477 provides: "The right-of-way for the construction of highways over public lands, not reserved for public uses, is hereby granted."

In order for a right-of-way to be granted under this statute, the following criteria must be met: The claimed right-of-way must have been located on unreserved public lands; it must have been actually constructed; and it must have been a highway. Once an asserted right-of-way is found to meet these three criteria, it is considered valid. The scope of the right-of-way is then determined.
The proponent of an R.S. 2477 right-of-way bears the burden of proof to demonstrate that a highway right-of-way was constructed. It is the proponent's burden to demonstrate this by a preponderance of the evidence. NPS looked to the proponent, San Juan County, to sustain this burden by presenting credible evidence that would lead a reasonable person to conclude that it was more likely than not that the statutory criteria of R.S. 2477 were met. That is, it is the county's burden to show that "construction" of a "highway" over "unreserved public lands" was more likely than not to have occurred. While not required to do so, NPS conducted additional research to locate any other relevant information. Also, the Bureau of Land Management (BLM) is in possession of the most complete information about the reserved status of public lands. At the request of NPS, BLM reviewed the public land records for information related to the historical status of the lands in Salt Creek Canyon and vicinity. All evidence was considered in making this determination.

1. Unreserved Public Land

Historically, public lands were open or available for right-of-way acquisition, mineral development, homesteading, or other uses. From time to time, Congress or the Executive Branch "withdrew" or "reserved" areas of public land, making them unavailable for some or all of these purposes after the dates of the orders. Under R.S. 2477, a highway right-of-way cannot be perfected on lands that have been withdrawn from entry or reserved for other public purposes. The statute requires that the land be unreserved at some time when construction occurred in order for the highway right-of-way to have been validly granted. In any case, the Federal Land Policy and Management Act (FLPMA) repealed R.S. 2477 on October 21, 1976, and no new highway rights-of-way could have been acquired after that date. BLM examined its public land records to determine if and when the public lands subject to the claimed highway right-of-way were withdrawn, reserved, or otherwise

unavailable pursuant to R.S. 2477.

2. Construction

Under R.S. 2477, actual construction of the claimed highway right-of-way must have occurred during a period when the public lands were available (i.e., not withdrawn or reserved). Some form of mechanical construction must have occurred to create or improve the highway. A highway right-of-way cannot be established by haphazard, unintentional, or incomplete actions. For example, the mere passage of vehicles across the land, in the absence of any other evidence, is not sufficient to meet the construction criteria of R.S. 2477 and to establish that a highway right-of-way was granted.

Evidence of actual construction may include such things as road construction or maintenance records, aerial photography depicting characteristics of physical construction, physical evidence of construction, testimony or affidavits affirming that construction occurred, official United States government maps with legends showing types of roads, as well as other kinds of information.

NPS evaluated all information submitted by San Juan County and other evidence compiled by NPS and/or BLM, and conducted on-site inspections to determine if actual construction of the claimed highway right-of-way had occurred prior to the repeal of R.S. 2477 on October 21, 1976, and prior to any reservation of the land including Salt Creek Canyon.

3. Highway

A highway is a thoroughfare used by the public for the passage of vehicles carrying people and goods from place to place. The claimed highway right-of-way must be public in nature and must have served as a highway when the underlying public lands were available for R.S. 2477 purposes. It is unlikely that a route used by a single entity or used only a few times would qualify as a highway. Similarly, a highway connects the public with identifiable destinations or places. The route should lead vehicles somewhere, but it is not required that the route connect cities. For example, a highway can allow public access to a scenic area, a trail head, a business, or other place used by and open to the public. Routes that do not lead to an identifiable destination are unlikely to qualify.

NPS evaluated all evidence submitted by San Juan County and compiled by NPS and/or BLM. Materials reviewed include cadastral survey notes and plats, official BLM public land records, BLM range and grazing files, planning documents, aerial photographs, other federal agency records, state and federal maps, and other information.

4. Scope

Scope is the set of physical attributes of a road that are reasonable and necessary for the type and extent of uses existing when the lands underlying the right-of-way were last reserved from operation of R.S. 2477 or October 21, 1976, if the lands were still subject to operation of R.S. 2477 on that date. These attributes include width and alignment, beginning and end points, and surface

treatment. The burden of establishing scope is on the proponent of the claim, and the proponent must demonstrate this by a preponderance of the evidence. In the absence of evidence otherwise, the scope of an R.S. 2477 right-of-way is assumed to be the physical attributes of the route on the date the underlying lands were removed from operation of R.S. 2477.

II. Summary of Comments Received and Records Reviewed

A. Evidence Submitted by San Juan County

San Juan County provided affidavits from five people, including four regarding past use and/or possible road construction in Salt Creek Canyon. County Planner Ed Sherick orally advised NPS that that the county has no other relevant records or information. The county road supervisor orally advised NPS that there were no road maintenance records for Salt Creek. Subsequently, County Commissioner Bill Redd sent a letter referring to the affidavits already provided, and suggesting that the NPS review air photos and USGS topographic maps "produced during the subject time period."

B. Evidence Sought and/or Collected by NPS

1. U.S. Public Land Records

At the request of the NPS, the BLM conducted extensive reviews of the United States public land records to determine whether the public lands underlying the claimed right-of-way were withdrawn, reserved, or otherwise unavailable for establishment of an R.S. 2477 right-of-way. Records BLM reviewed included Master Title Plats, the Historical Index, the Control Document Index, and the Index to Miscellaneous Documents.

2. Public Land Survey System (PLSS) Records

NPS also consulted cadastral survey plats and notes for the lands underlying the claimed right-of-way. The cadastral field notes and plats show topographic features along the surveyed section lines, some of which are at the approximate location of the claimed route, e.g., trails, ridge tops, hollows, bottoms of canyons, etc.

3. BLM Range Improvement Project Files and Road Maintenance Records

BLM reviewed all grazing-related files and road maintenance records relevant to the public lands underlying the claimed route.

4. Maps and Aerial Photography

NPS reviewed relevant federal and state government maps from 1953 to 1984, as well as aerial

photography relevant to the asserted claim taken between 1952 and 1966, to assist in determining whether the claimed route was created or improved by mechanical means and served as a highway. For example, if long continuous sections of a route appear to be straight in an aerial photograph, those sections were possibly mechanically constructed, since large obstacles encountered during construction of the route likely could only be removed mechanically.

5. NPS Planning Documents

NPS reviewed all relevant available land use planning documents. This included a 1962 proposal for a new park, the first park master plan, done in 1965, and a 1973 transportation study.

6. Interviews

NPS interviewed a number of people who had been in Salt Creek prior to the establishment of Canyonlands National Park in 1964, including two of the four people who provided affidavits submitted by San Juan County on past use or possible road construction. NPS also requested interviews with the other two affiants, but each declined.

7. County Construction and Maintenance Records

Construction and maintenance records are the best evidence for determining whether a claimed R.S. 2477 right-of-way was mechanically constructed or improved; however, no such records were provided by San Juan County.

8. Other Federal Agency Records

NPS reviewed records from the Central Federal Lands Highway Division, Bureau of Public Roads, to seek information on projects constructed by the Bureau of Public Roads on behalf of the Atomic Energy Commission.

9. Other Publicly Available Information

NPS reviewed published magazines and journals for information relevant to establishment of the claimed right-of-way. Articles about early exploration of the Needles area and Salt Creek were published in *Arizona Highways* (May 1950), *National Geographic* (May 1962), and the *Canyon Legacy* (journal of the Dan O'Laurie Canyon Country Museum, Fall 1989).

III. Analysis of San Juan County Claim

The following sections evaluate San Juan County's claimed right-of way in Salt Creek Canyon based on the evidence gathered to date.

A. General History of the Area

By 1200 A.D., Salt Creek was one of a number of southwestern canyons with well-watered alluvial bottomland where Ancestral Puebloan (or Anasazi) people concentrated. After 1300 A.D., these people had left, and occupation and use of the area was sparse and transitory. There was little Euroamerican exploration of the future Canyonlands National Park even through the late nineteenth century.

Ranchers and settlers began moving into San Juan County in the 1880s, but the area remained thinly populated and remote. Population grew in the 1950s with the uranium boom, when prospectors arrived and combed previously unexplored public lands. In 1965, the nearest town to the Needles district, Monticello, had a population of 1,700 people. The next closest towns, Blanding and LaSal, had 1965 populations of 1,675 and 90, respectively. By 1974, the average population of Utah on the whole was 11 people per square mile, while San Juan County had 1.2 people per square mile.

B. Description of Salt Creek

Canyonlands National Park lies within the vast interior erosional basin formed on the uplifted Colorado Plateau. The carved and eroded basin is characterized by deeply entrenched rivers and intermittent streams that have created a labyrinth of canyons on three distinct levels within the park area. The region as a whole is a rugged, deeply eroded desert. Red sandstone, carved into fantastic shapes and deep canyons, dominates the landscape.

Salt Creek, in the Needles District of the park, is in a remote part of southeastern Utah, approximately 50 miles from the nearest town (Monticello). Salt Creek supports one of the most important riparian ecosystems in the park. It is also the heart of the Salt Creek Archeological District, the area with the highest recorded density of archeological sites in the park. A tributary canyon to Salt Creek contains the spectacular Angel Arch.

Salt Creek begins on the north side of the Abajo Mountains in Manti-LaSal National Forest, about five miles south of the southern boundary of Canyonlands National Park. From the south park boundary the creek runs northerly about 32 miles, where it joins the Colorado River. Sections of the creek have year-round surface water, supported by several springs. In other sections surface flow is intermittent, resulting from spring snowmelt and storm runoff, and the water table drops below the surface for parts of the year. Surface and ground water associated with the creek support the most extensive riparian ecosystem in the park, other than the Green and Colorado Rivers.

Knowledge of the Needles area, including Salt Creek, was limited to nearby ranchers and cowboys until the early 1950s. At that time, a few recreationists and uranium prospectors began to explore the Needles area by horseback, foot, or jeep, including Salt Creek Canyon, where they traveled in and alongside the streambed. After Canyonlands National Park was created in 1964, the park continued to allow motorized, street-legal vehicles to travel in Salt Creek.

The Salt Creek four-wheel-drive route is a single lane unimproved track that runs from a gravel park road in the vicinity of Cave Spring, for approximately 11 miles to a side canyon sometimes known as Angel Arch Canyon, then continues another mile up this side canyon to the terminus in the vicinity of Angel Arch. Above Angel Arch Canyon, the creek continues approximately 12 miles to the south park boundary. The jeep route weaves in and out of the streambed, crossing the channel 60 times in the 9.5 miles between Horse Canyon and the Angel Arch turnoff, and sometimes remains in the streambed for extended lengths. Below Cave Spring, the creek continues for about 9 miles to its confluence with the Colorado River.

Maintenance of the route is limited to occasional grading or filling by the NPS of sections that have become impassable because of flooding or erosion from vehicle travel. Vehicle passage can be challenging, and quicksand along the route periodically traps vehicles. (After recent flooding, two NPS four-wheel-drive vehicles and a backhoe were trapped.) There are no human-made road-related structures (culverts, bridges etc.) along the route. The only other human-made structures in the canyon are the remnants of a fence, associated with cattle grazing prior to the 1970s, an adit (horizontal tunnel) possibly constructed for uranium prospecting, and archeological structures.

C. Evidence Related to Public Land Status

1. Relevant Withdrawals and Reservations

Public Land Order 130 was in effect from May 26, 1943 to January 4, 1945, when it was revoked by Public Land Order 256. Public Land Order 130 temporarily withdrew lands from settlement, location, sale, and entry, and reserved them for prospecting and development under the mineral-leasing laws. This withdrawal affected public lands underlying the length of the Salt Creek jeep route, as well as the remainder of the creek within what is now Canyonlands National Park.

A withdrawal (number U-087819) in support of legislation to establish Canyonlands National Park became effective April 4, 1962. This action withdrew land from all forms of appropriation except leasing under the mineral leasing laws, location and entry of metalliferous minerals under the mining laws, and grazing. This withdrawal affected public lands underlying the length of the Salt Creek jeep route, as well as the remainder of the creek within Canyonlands National Park, except for portions of Sections 20, 28, and 29 underlying the creek in Township 32 South, Range 20 East, which were added to the park in 1971.

Therefore, to qualify as a valid R.S. 2477 right-of-way, San Juan County's Salt Creek claim must have been constructed as a highway before May 26, 1943 or between January 4, 1945 and April 3,

1962. During all other periods, the subject lands were not available for establishing an R.S. 2477 right-of-way.

2. Other Information Regarding Land Status

Public Law 88-590 establishing Canyonlands National Park was signed into law September 12, 1964, and affected the same lands underlying Salt Creek listed above in the 1962 withdrawal. Public Law 92-154 revising the boundaries of Canyonlands National Park was signed into law on December 12, 1971. This act added to the park public land in portions of Sections 20, 28, and 29 underlying Salt Creek in Township 32 South, Range 20 East. This included part of upper Salt Creek, approximately four miles upstream from the terminus of the jeep route.

Part of a section underlying Salt Creek upstream from the jeep route, the west half of the southeast quarter of Section 20, Township 32 South, Range 20 East, was granted to the state of Utah as indemnity for land lost due to the reservation of the LaSal National Forest as of May 25, 1922. This tract was later transferred to private ownership, but BLM has no records for the period after the transfer to state ownership. Canyonlands National Park acquired this tract on December 12, 1976. Because the tract was conveyed to the state of Utah, it was not available for the establishment of an RS 2477 right-of-way after May 25, 1922 since it was not public domain land.

There were no applications or patents for homesteads on the lands underlying Salt Creek within current-day Canyonlands National Park.

There were no patented mining claims on the lands underlying Salt Creek within current-day Canyonlands National Park. Prior to the passage of the Federal Land Policy and Management Act in 1976, records of unpatented mining claims were filed with the counties. San Juan County provided no records of unpatented mining claims along Salt Creek.

D. Evidence Related to Construction and Highway

1. Site Inspections

NPS staff made site inspections during the course of ranger patrols and resource assessments. The inspections found no human-made road structures (pavement, culverts, cattle guards, etc.). There are occasional indications of possible grading on the route, but it is impossible to ascertain whether such grading occurred before 1962, when Salt Creek Canyon was withdrawn. Remnants of an historic fence exist in the canyon, associated with livestock grazing activity that occurred from the late nineteenth century until the 1970s. An adit (horizontal tunnel in a canyon wall), possibly associated with uranium prospecting activity, is also located in the canyon.

2. Maps

Records of construction and/or maintenance and on-site observation are the best methods for

determining whether a route was created or improved by mechanical means. Maps are useful in determining whether a route leads to a specific destination or place. The following is a summary of findings made by NPS after consulting various maps prepared by the USGS, U.S. Forest Service, BLM, Utah State Department of Highways, and San Juan County.

The following table shows the date of the maps reviewed and whether the claimed right-of-way appears in full or in part.

Maps

Date	Claimed Route
1956 (based on aerial photography from 1953)	N
1958 (based on aerial photography from 1953)	N
1959	N
1965	N
1965	N
1969	Y ("Jeep Trail")
1970	N
1974	Apparent road is hand-drawn in, after publication of map

Y=Claimed route appears
N=Claimed route does not appear

3. Aerial Photography

NPS reviewed aerial photography taken by the U.S. Geological Survey between 1952 and 1966. The following table summarizes whether the claimed right-of-way appears in photographs taken during this period.

Aerial Photography

Date	Claimed Route
1952	NV
1952	NV
1966	V

V=Visible
NV=Not Visible

4. Public Land Survey System (PLSS) Records

The NPS also consulted cadastral survey notes and plats for the lands underlying the claimed right-of-way. Surveyors for the General Land Office and the Bureau of Land Management completed Cadastral Surveys in the area in 1911, 1927 and 1957. The purpose of these surveys was to locate boundary lines of specific townships and/or sections. These boundary lines were in the vicinity of Salt Creek, and in some cases, though not necessarily, crossed the creek. Surveyors made notes of geographic features, including roads or trails, that the survey lines crossed. In cases where surveyors noted other features, but not roads or trails, along survey lines, it may be reasonable to infer that no road or trail existed where the survey line crossed Salt Creek when that survey occurred.

Notes from the 1911 surveys of portions of Townships 32 South, Range 20 East, and Township 33 South, Range 20 East (outside of the south boundary of current-day Canyonlands National Park) identify trails, but no roads, near the upper main and east forks of Salt Creek.

Notes from the 1927 survey of Township 30 South, Range 20 East, make note of "Salt Creek Wash," a trail approximately one-half mile from Salt Creek, and a road in Lost Canyon, as well as other features, but makes no mention of a road or trail in Salt Creek.

In the 1957 survey of portions of Township 30½ South, Range 20 East, the survey lines paralleled but did not cross Salt Creek. However, the notes do mention that "this township is not accessible by motor vehicle."

Notes from the 1957 survey of portions of Township 31 South, Range 20 East, and Township 31 South, Range 19 East, identify nine points where survey lines cross Salt Creek between the Upper Jump and Cave Spring (the area of the jeep route). For eight of these, no road or trail is mentioned. In one of these survey line crossings of Salt Creek (downstream from Peekaboo Spring) the surveyors note a "jeep road."

It is apparent from these notes that the surveyors generally did not record the existence of the claimed right-of-way. In 1957, a "jeep road" was identified at one location where the survey line crossed Salt Creek Canyon, approximately one-half mile northeast of Peekaboo Spring. However, no road or trail was noted at eight other survey line crossings of the canyon, and another survey, which parallelled but did not cross the canyon, called the surveyed township "inaccessible by motor vehicle." The note on the jeep road makes no mention that it was mechanically constructed or improved.

5. BLM Public Land Records

a. Grazing and road records

At the request of NPS, BLM reviewed all available public land records which might indicate whether construction of a road in Salt Creek Canyon had occurred prior to the establishment of Canyonlands National Park. Records examined included Range Improvement Project Files, Project Summaries and Records from 1935 through 1964, the Master File of Projects for BLM District 6 (Monticello), and road inventories. BLM did not find any record of a road or trail in Salt Creek Canyon prior to the establishment of the park. There was some grazing activity in Salt Creek Canyon. Grazing records can indicate if road construction occurred due to the grazing activity Here, no such evidence is revealed by the grazing files. There is no documented installation of cattle guards, culverts, etc., or other evidence of construction of a road.

b. San Juan County assertions of RS2477 in BLM Records

BLM records include a memorandum dated May 9, 1984, signed by Edward Sherick as authorized officer of the Monticello BLM office, which refers to a "General Highway Map, San Juan County Utah," prepared by the Utah State Department of Highways, 1970, with additional information

added by San Juan County (included in map listing above). According to the memo, this map was submitted by San Juan County in May 1984 to identify all roads in the county constructed under the authority of R.S. 2477 prior to the passage of the Federal Land Policy and Management Act of 1976. The map identifies several roads within Canyonlands National Park, but does not show a road or trail in Salt Creek Canyon.

6. San Juan County/NPS Road Maintenance Records

NPS maintenance records do not contain any information relevant to whether the jeep route in Salt Creek Canyon was mechanically constructed or improved prior to the establishment of the park, nor whether it served as a highway during the time in which the lands were available for establishing a right-of-way under R.S. 2477.

The NPS asked San Juan County for any maintenance records it may have regarding the subject area; however, the county replied that they had none.

In the 1960s and 1970s, there was a Memorandum of Agreement between the NPS, San Juan County, and Utah Department of Transportation for maintenance of the external approach road to the Needles district (not the Salt Creek jeep route). This is the only agreement between the San Juan County and the NPS for road maintenance.

NPS records do indicate that the Salt Creek jeep route was occasionally maintained by the NPS *after* the establishment of the park, and that San Juan County did not contribute to the maintenance of the route. In a few instances, NPS used front-end loaders or other heavy equipment to grade or fill sections that had become impassable.

7. NPS Planning Documents

NPS reviewed all relevant available land use planning documents. This included a 1962 proposal for a new Canyonlands National Park, the first park master plan, done in 1965, and a 1973 transportation study. The following table shows the dates of the documents reviewed and whether the claimed right-of-way appears.

NPS Planning Documents

Date	Claimed Route
1962	Y ("Proposed Jeep Route")
1965	Y ("Existing Jeep Route")
1973	N

Y=Claimed route appears
N=Claimed route does not appear

8. Other Federal Agencies' Records

NPS reviewed records from the Central Federal Lands Highway Division, Bureau of Public Roads, to seek information on projects constructed by the Bureau of Public Roads on behalf of the Atomic Energy Commission. No roads or projects constructed by the Bureau of Public Roads are located within Salt Creek Canyon.

9. Oral Evidence

NPS interviewed a number of people who had been in Salt Creek prior to the establishment of Canyonlands National Park in 1964, including two of the four people who provided affidavits submitted by San Juan County on past use or possible road construction, Kent Frost and Rigby Wright. NPS also requested interviews with the other two affiants, Max Black and Kedric Somerville, but each declined. Both stated that they supported the county's efforts; Mr. Somerville stated that he didn't want to "do anything that detracts from what the county is trying to do."

- Interviewee/affiant Kent Frost claimed in his interview to have actually seen a bulldozer in Salt Creek, in the late 1950s. He first visited Salt Creek in 1952, and stated in his interview that he thought no bulldozing had been done at that time. He stated in his affidavit that "uranium mining constructed part of the road in the 1950's."
- Interviewee John Scorup thought he had seen evidence of bulldozing (blade marks), but thought it had been done prior to his first visit in 1956, and that there had been no further bulldozing after this.
- Interviewee/affiant Rigby Wright stated in his affidavit that "when I first used and observed the road in 1958, the road had clear indications beyond Peekaboo Springs going up toward Angel Arch of a grader improving the road. There were berms and edges that clearly showed bulldozer maintenance of the road." In his interview, he pointed out that there was an error in his affidavit immediately following the previous sentences. The phrase "the road goes eight or nine miles to Angel Arch Canyon where an old cowboy camp is located" is incorrect; the old cowboy camp is actually located about 3.5 miles above Peekaboo Spring. Mr. Wright also clarified in the interview that he had gotten stuck in quicksand at this point (the old cowboy camp) on his first trip and had turned back rather than continuing the remaining 6.5 miles to Angel Arch, and that he had not traveled the entire distance to Angel Arch until immediately before the park was established. He did not know who might have done the bulldozing.
- Affiant Kedric Somerville stated in his affidavit that a road in Salt Creek had been constructed and maintained by bulldozer or "equipment," all the way up to the "jump area," "evidenced by signs of excavation that were old" when he first went on it in 1960. His affidavit also stated that "construction was also performed by the passing of motorized vehicles over the roadway."
- Affiant Max Black made no mention of road construction in his affidavit.
- Interviewee Lloyd Holyoak had not witnessed bulldozing or signs of it on his visits to Salt Creek from 1949 through 1951 and in the late 1950s.
- Interviewee Alan Wilson had not witnessed bulldozing or signs of any construction activities on his visits to Salt Creek from 1950 through 1959.

- Interviewee Sam Taylor had not witnessed bulldozing or signs of any construction activities on his visits to Salt Creek in 1951 and between 1956 and 1964.
- Interviewee Jimmie Walker had not witnessed bulldozing or signs of any construction activities on his visits to Salt Creek in the early to mid 1950s.
- Interviewee Lloyd Pierson had not witnessed bulldozing or signs of any construction activities on his visits to Salt Creek from 1957 to 1961.
- Interviewee Mitch Williams had not witnessed bulldozing or signs of any construction activities on his visits to Salt Creek from 1960 through the establishment of the park in 1964.

10. Other Publicly Available Information

A few published articles in magazines and journals describe exploration of the Needles area and Salt Creek Canyon in the 1950s. These articles describe Salt Creek Canyon as remote and difficult to access. They discuss driving jeeps though the sandy creekbed, including instances of jeeps getting stuck in quicksand, as well as travel by foot, horse, and technical rock climbing. They make no mention of road construction in Salt Creek Canyon.

E. Conclusion

1. Land Status

The public land underlying San Juan County's claimed right-of-way in Salt Creek Canyon was reserved from May 26, 1943 to January 4, 1945, then from April 4, 1962 until present. Therefore, it was available for establishment of a right-of way under R.S. 2477 prior to May 26, 1943 and between January 4, 1945 and April 4, 1962.

2. Construction

San Juan County provided several affidavits, but did not provide any documentation, relative to whether its claimed right-of-way was mechanically created or improved. NPS collected and reviewed all available information in an effort to determine whether the route was created or improved in such a manner as to satisfy the requirements of R.S. 2477.

The PLSS records indicate that no road was observed in the subject area any time before 1957 when the last cadastral survey was completed prior to transfer of the land to the NPS. Records from the 1957 surveys are equivocal as to the extent or nature of the road. The PLSS records do not indicate whether the jeep route was mechanically constructed or improved.

Maps prepared by USGS and the State of Utah do not indicate the existence of a trail or road prior to 1969, when a "jeep trail" along Salt Creek appeared on the revision of the USGS 15 minute topographic map for the area.

NPS planning documents identify a "proposed jeep route" in 1962, prior to the establishment of the

park, and an "existing jeep route" in 1965, after the establishment of the park.

Aerial photography from 1952 and 1953 does not indicate the existence of a trail or road. A road is visible on aerial photographs taken in 1966.

BLM public land records do not offer any information regarding any road construction in Salt Creek Canyon.

San Juan County provided affidavits from three early travellers in Salt Creek which suggested that the route may had been constructed or improved by mechanical means. However, several other early travellers stated in interviews that the route had not been mechanically improved or constructed prior to the establishment of Canyonlands National Park. There is no evidence that the State of Utah or San Juan County ever mechanically constructed or improved the jeep route.

Based on this information NPS finds that construction of the route has not been established by a preponderance of the evidence at a time when the lands were open for establishment of a right-of-way under R.S. 2477. There is insufficient reliable evidence to demonstrate that San Juan County or any other party used mechanical means to construct or improve a highway in Salt Creek Canyon prior to the reservation of the area in 1962.

3. Highway

San Juan County provided several affidavits, but did not provide any documentation, relative to whether the asserted right-of-way served as a highway when the underlying lands were available for the creation of an R.S. 2477 right-of-way. NPS collected and reviewed all available information in an effort to determine whether the claimed route met the "highway" standard.

Due to the remoteness of the area and distance from nearby towns such as Monticello (50 miles) and Moab (75 miles), use of the Needles area, including Salt Creek Canyon, was limited.

No maps or other documents indicate that the route was recognized as a public highway or thoroughfare during the period that the area was available for establishment of an R.S. 2477 right-of-way.

The county provided affidavits from four early Salt Creek travellers that described use of the route during the 1950s and 1960s. Interviewees also described use during this period. No affiants, interviewees, or written or printed evidence indicate that the route was established by a local, state or federal government during the period when the lands were open for establishment of a claim under R.S. 2477.

One destination on the route was Angel Arch, a prominent feature in Canyonlands National Park. Alan Wilson, an early Needles-area explorer, states (in an interview with NPS and an article published in the *Canyon Legacy* journal) that there was not much knowledge of Angel Arch until 1952 or 1953, when it was "discovered." Interviews and other articles indicate that exploration was

done in Salt Creek Canyon throughout the 1950s, with trips generally heading toward Angel Arch, but not always reaching it due to the rugged nature and distance of the trip.

Based on this information, it appears that the public highway criterion for establishing an R.S. 2477 right-of-way has not been met by a preponderance of the evidence. There is insufficient reliable evidence to demonstrate that San Juan County or any other party laid out, constructed, or otherwise declared a public highway in Salt Creek prior to the reservation of the area in 1962.

4. Scope

The scope of the claimed right-of-way is the width, alignment, surface treatment, and other highway features that existed when the public lands subject to the claim were reserved. Scope of the claimed route will not be considered until such time as a claim can be established.

IV. Preliminary Assessment

NPS has collected and reviewed available evidence with respect to San Juan County's R.S. 2477 claim in Salt Creek Canyon. Based on this information, it appears that an R.S. 2477 right-of-way was not established in Salt Creek Canyon. Existing known evidence does not show by a preponderance of the evidence that the route meets the standard for an R.S. 2477 right-of-way. A formal public notification should be carried out and a determination made based upon notice and the opportunity for the public to provide any additional information that may exist regarding the establishment of an R.S. 2477 right-of-way in Salt Creek Canyon.